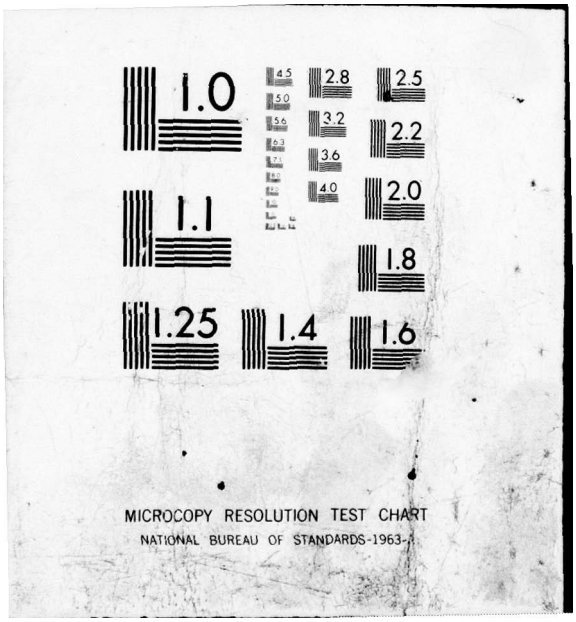
AD-A079 006 GAI CONSULTANTS INC MONROEVILLE PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. MEADOW GROUNDS DAM, NDS I.D. N--ETC(U)
AUG 79 B M MIHALCIN DACW31-79-C-0013

UNCLASSIFIED NL

1 OF 2
AD-
A079 006


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
8.0
9.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

AD A079006

(1)

(6) POTOMAC RIVER BASIN

ROARING RUN, FULTON COUNTY

National Dam Inspection Program.

PENNSYLVANIA

MEADOW GROUNDS DAM,

(NDS I.D. Number PA-00185,

PENNDER I.D. Number 29-32)

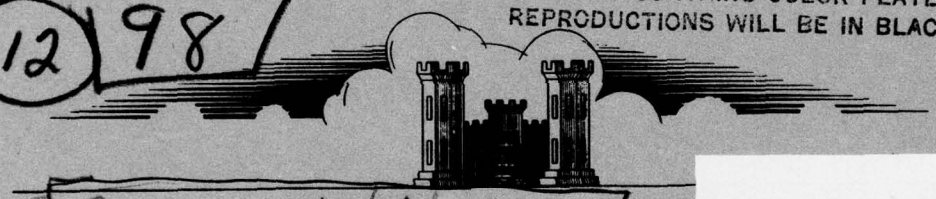
Potomac River Basin, Roaring Run, Fulton County, Pennsylvania.

LEVEL

PHASE I INSPECTION REPORT.
NATIONAL DAM INSPECTION PROGRAM

(12) 98

ORIGINAL CONTAINS COLOR PLATES: ALL DTIC REPRODUCTIONS WILL BE IN BLACK AND WHITE



(10) Bernard M. Mihaldin

Distribution Unlimited
Approved for Public Release
Contract No. (15) DACW31-79-C-0013

PREPARED FOR

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

DDC FILE COPY

DDC
RECEIVED
JAN 9 1980
A

PREPARED BY

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

(11) AUGUST 1979

411002 80 7 1 076

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DDC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition, and the downstream damage potential.

Accession For
NTIS GRA&I
DDC TAB
Unannounced
Justification
By
Distribution/
Availability Codes
Dist. | Avail and/or special

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Meadow Grounds Dam: NDI I.D. No. PA-00185

Owner: Pennsylvania Fish Commission

State Located: Pennsylvania (PennDER I.D. No. 29-32)

County Located: Fulton

Stream: Roaring Run

Inspection Date: 10 August 1979

Inspection Team: GAI Consultants, Inc.
570 Beatty Road
Monroeville, Pennsylvania 15146

Based on a visual inspection, operational history, and available engineering data, the dam is considered to be in good condition.

The size classification of the facility is intermediate and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility is the Probable Maximum Flood (PMF). Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store about 92 percent of the PMF prior to embankment overtopping. Consequently, the spillway is assessed as being inadequate, but not seriously inadequate.

Deficiencies at the facility are confined to seepage along the abutment-embankment contacts (particularly the left abutment) and poorly drained conditions downstream of the outlet conduit.

It is recommended that the owner:

a. Evaluate the outlet works channel and take necessary remedial measures to provide unimpeded discharge through the channel.

b. Accurately map the seepage locations at the embankment-abutment contact and immediately downstream of the embankment and design an effective drainage system to eliminate observed ponding and swamp-like conditions.

c. Assess the seepage, particularly at the embankment-abutment contact, during all future inspections to determine if it is encroaching onto the embankment, and if so, take further appropriate remedial measures.

d. Reevaluate and revise the present standard flood emergency procedures in accordance with, but not limited to, the following items:

1. Include a definite procedure of notifying downstream residents of a possible emergency.

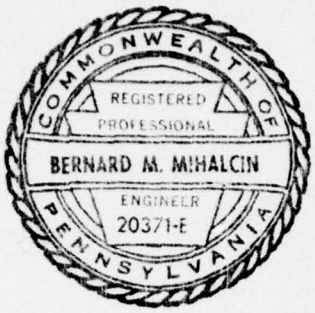
2. Provide for an alternate means of communication in the event telephone lines become inoperative.

3. Provide for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

GAI Consultants, Inc.

Bernard M. Mihalcin

Bernard M. Mihalcin

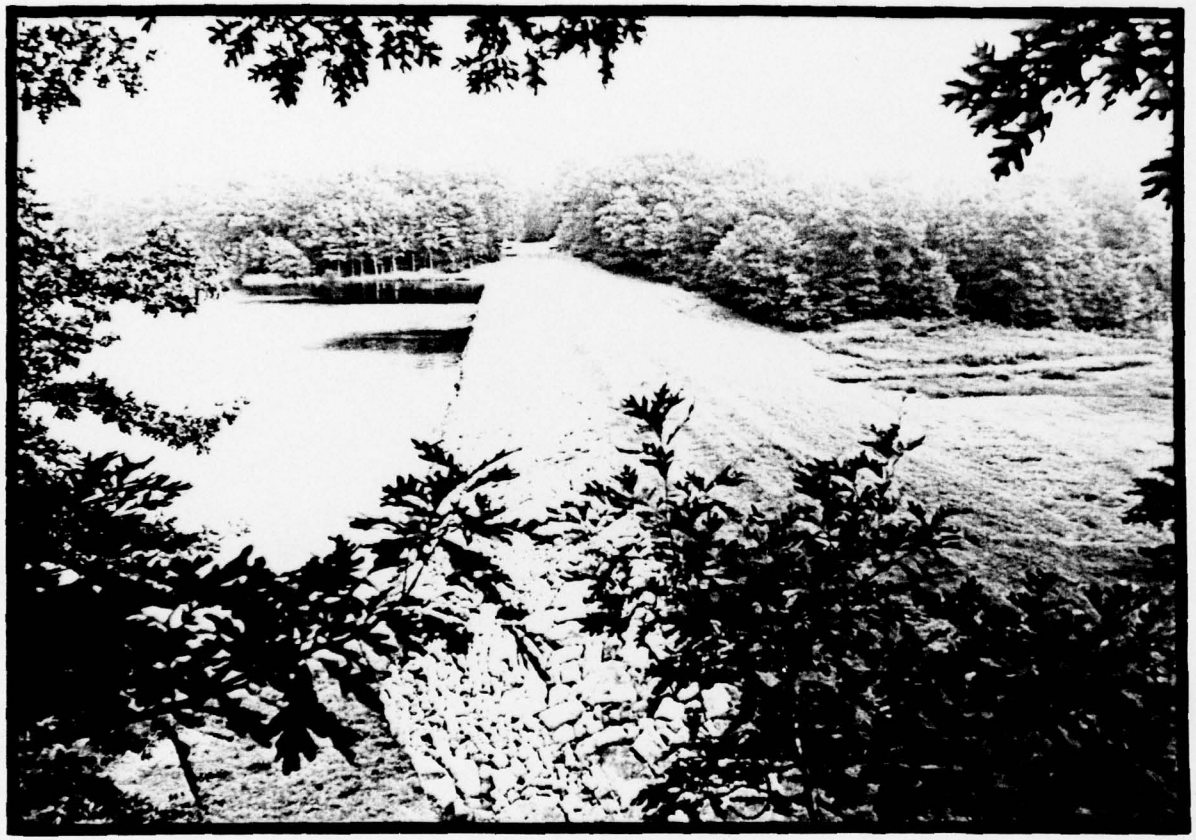


Date 18 Sept 1979

Approved by:

James W Loch

Date 25 Sep 79



OVERVIEW PHOTOGRAPH

TABLE OF CONTENTS

	Page
PREFACE	i
ABSTRACT	ii
OVERVIEW PHOTOGRAPH	v
TABLE OF CONTENTS	vi
SECTION 1 - GENERAL INFORMATION	1
1.0 Authority	1
1.1 Purpose	1
1.2 Description of Project	1
1.3 Pertinent Data	2
SECTION 2 - ENGINEERING DATA	5
2.1 Design	5
2.2 Construction Records	6
2.3 Operational Records	6
2.4 Other Investigations	6
2.5 Evaluation	6
SECTION 3 - VISUAL INSPECTION	7
3.1 Observations	7
3.2 Evaluation	8
SECTION 4 - OPERATIONAL PROCEDURES	9
4.1 Normal Operating Procedure	9
4.2 Maintenance of Dam	9
4.3 Maintenance of Operating Facilities	9
4.4 Warning System	9
4.5 Evaluation	10
SECTION 5 - HYDROLOGIC/HYDRAULIC EVALUATION	11
5.1 Design Data	11
5.2 Experience Data	11
5.3 Visual Observations	11
5.4 Method of Analysis	11
5.5 Summary of Analysis	11
5.6 Spillway Adequacy	12
SECTION 6 - EVALUATION OF STRUCTURAL INTEGRITY	13
6.1 Visual Observations	13
6.2 Design and Construction Techniques	13
6.3 Past Performance	14
6.4 Seismic Stability	14
SECTION 7 - ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES	15
7.1 Dam Assessment	15
7.2 Recommendations/Remedial Measures	15

TABLE OF CONTENTS

APPENDIX A - CHECK LIST - ENGINEERING DATA
APPENDIX B - CHECK LIST - VISUAL INSPECTION
APPENDIX C - HYDROLOGY AND HYDRAULICS
APPENDIX D - PHOTOGRAPHS
APPENDIX E - GEOLOGY
APPENDIX F - FIGURES
APPENDIX G - REGIONAL VICINITY AND WATERSHED BOUNDARY MAPS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
MEADOW GROUNDS DAM
NDI# PA-185, PENNDER# 29-32

SECTION 1
GENERAL INFORMATION

1.0 Authority.

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Meadow Grounds Dam is a zoned earth embankment approximately 39 feet high and 530 feet long (not including spillway). The facility is provided with a trapezoidal-shaped channel spillway having a free overfall type weir. The spillway is cut through the right abutment approximately 200 feet to the right of the dam embankment (see Figure 3) and has a weir length of 67 feet. The outlet works consist of a 4-foot square (inside dimension) box culvert that discharges at the downstream embankment toe. Flow through the culvert is regulated via stoplogs set within a concrete vertical riser positioned along the upstream embankment face.

b. Location. Meadow Grounds Dam is located on Roaring Run in Ayr Township, Fulton County, Pennsylvania, about 4 miles north of the village of Big Cove Tannery. The dam, reservoir, and watershed are located within the Meadow Grounds, Pennsylvania, 7.5 minute U.S.G.S. topographic quadrangle. The coordinates of the dam are N39° 55' and W78° 03' (see Appendix G).

c. Size Classification. Intermediate (39 feet high; 4,670 acre-feet storage capacity at top of dam).

d. Hazard Classification. High (see Section 3.1.e).

e. Ownership. Pennsylvania Fish Commission
P. O. Box 1673
Harrisburg, Pennsylvania 17120

f. Purpose. Public fishing.

g. Historical Data. Meadow Grounds Dam was completed in June 1964. Both the design and construction of the facility were undertaken by the Pennsylvania Fish Commission (PFC). No major problems were reportedly encountered during construction; however, upon reservoir filling, seepage began emanating from the left abutment-embankment contact prompting the remedial extension of the toe drain. Other than the seepage and minor displacement of spillway riprap the facility has operated satisfactorily since completion.

1.3 Pertinent Data.

a. Drainage Area (square miles). 3.2.

b. Discharge at Dam Site.

Discharge Capacity of Outlet Conduit - Discharge curves are not available.

Discharge Capacity of Spillway at Maximum Pool ≈ 4510 cfs (see Appendix C, Sheet 9).

c. Elevation (feet above mean sea level). The following elevations were obtained from design drawings and field measurements based on a bench mark located at the right abutment with designated elevation 1502.0 feet. [1995.3 msl = 55.0 relative datum on spillway crest].

Top of Dam	1501.3 (design) 1501.7 (field measured low spot)
Maximum Design Pool	Not Known
Maximum Pool of Record	Not Known
Normal Pool	1495.3
Spillway Crest	1495.3 (55.0 relative datum).
Upstream Inlet Invert	1464.3
Downstream Outlet Invert	1463.1
Streambed at Dam Centerline	1464 (estimated)
Maximum Tailwater	Not Known

d. Reservoir Length (miles).

Top of Dam	1.8
Normal Pool	1.6

e. Storage (acre-feet).

Top of Dam	4670
Normal Pool	3130
Design Surcharge	Not Known

f. Reservoir Surface (acres).

Top of Dam	271
Normal Pool	204
Maximum Design Pool	Not Known

g. Dam.

Type	Zoned Earth.
Length	530 feet
Height	39 feet (field measured; crest to invert of outlet conduit).
Top Width	16 feet
Upstream Slope	3H:1V
Downstream Slope	2-1/2H:1V
Zoning	Embankment constructed with four (4) zones: Impervious core; class "A" fill; class "B" fill; pervious materials. See notes on Figure 6 for description of zone materials.
Cutoff	Shallow cutoff trench extending 2 feet into impervious stratum and backfilled with impervious core material as indicated on Figure 6.
Grout Curtain	None indicated.

h. Diversion Canal and Regulating Tunnels — None.

i. Spillway.

Type	Trapezoidal-shaped concrete lined channel cut in rock with trapezoidal-shaped free overfall weir structure.
Crest Elevation	1495.3
Crest Length	67 feet

j. Outlet Conduit.

Type	4-foot square reinforced concrete box culvert.
Length	202 feet (inlet to outlet).
Closure and Regulating Facilities	Flow through outlet is controlled via removable stop logs set in grooves within a reinforced concrete control tower riser.
Access	Control tower accessible from embankment crest.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. No formal design reports are available; however, design calculations, construction drawings, specifications, and photographs are available from PennDER and PFC files.

PFC files also contain the following reports:

1. Engineering Feasibility Report, E. R. Miller, 1962.

2. Biological Evaluation, T. C. Simes, 1959.

3. Subsurface Exploration Report, P. J. Gardosik, 1959.

b. Design Features.

1. Embankment. The contract drawings and specifications indicate the embankment is a zoned earth structure 39 feet high and 530 feet in length. The embankment is constructed with an impervious core and shallow cutoff trench comprised of selected impervious material. The impervious core is contained by Class "A" fill (see Note 2, Figure 6) on the upstream side and Class "B" fill (designated as "sound material sufficiently pervious to drain the embankment") on the downstream side. Contract drawings (see Figure 6) also indicate a downstream "pervious material" zone which is underlain by a toe drain. The dam is designed with the slopes of 3H:1V on the upstream side and 2-1/2H:1V on the downstream side. The design crest width is 16 feet and the upstream slope is protected by a 20-inch thick hand-placed layer of stone riprap extending from 4 feet below normal pool to the dam crest.

2. Appurtenant Structures.

a) Spillway. The spillway at Meadow Grounds Dam is a trapezoidal-shaped concrete chute cut into rock through a saddle about 200 feet to the right of the right abutment (see Figure 3). The spillway is provided with a free overfall trapezoidal-shaped weir, 67 feet in length, discharging into a concrete lined spillway basin approximately 40 feet in length (see Figure 8). The concrete wingwalls of the spillway extend 6 feet above the weir level.

b) Outlet Works. The outlet works consist of a reinforced concrete riser and a 4-foot square (inside dimension) box culvert which discharges at the downstream embankment toe (see Figure 7). Flow through the outlet is controlled via removable stoplogs set in grooves within the riser (see Photograph 10).

c. Specific Design Data and Criteria. Calculations available from PFC files indicate the embankment and appurtenances were designed in accordance with procedures and guidelines contained in the "Design Of Small Dams" by the U. S. Bureau of Reclamation and "Handbook of Hydraulics" by King and Brater. The spillway was sized to meet the PennDER "C" Curve requirements of 1100 csm for a 3.39 square mile drainage area.

Available calculations deal primarily with hydraulic and concrete design. No specific soils data, seepage or stability calculations are available.

2.2 Construction Records.

Design drawings, contract specifications, construction progress reports, and construction photographs are available from PennDER and PFC files. No field testing records are available.

2.3 Operational Records.

No records of the day-to-day operation of this facility are maintained.

2.4 Other Investigations.

A brief letter in PennDER files indicates that a dye study was performed shortly after seepage was noted upon reservoir filling.

2.5 Evaluation.

Engineering data in the form of contract drawings, specifications, miscellaneous calculations, and construction photographs are available from PennDER and PFC files. The data indicate the facility was designed and constructed in accordance with accepted engineering criteria and are considered adequate to make a reasonable Phase I evaluation of the facility.

SECTION 3
VISUAL INSPECTION

3.1 Observations.

a. General. The overall appearance of the facility suggests the dam and its appurtenances are currently in good condition.

b. Embankment. Field observations indicate the embankment is well maintained (see Photograph 2) and in good condition. Significant seepage and swamp-like conditions are evident, however, immediately downstream of the embankment toe, particularly along the left abutment (see Photographs 3, 4, and 12). A remedial drainage trench was installed along the left abutment shortly after reservoir filling, but is apparently ineffective. Apparent poor drainage conditions (possibly from beaver dams along the outlet discharge channel) have resulted in ponding and difficult maintenance conditions.

No embankment distress or seepage through the embankment face was observed.

c. Appurtenant Structures.

1. Spillway. Visual inspection revealed the spillway to be in good condition (see Photographs 6 and 7). No obstructions or concrete deterioration were observed. The channel immediately downstream of the stilling basin is adequately protected by hand-placed and/or dumped rock riprap (see Photograph 8).

2. Outlet Works. Visible portions of the outlet works were found to be in good condition (see Photographs 9, 10, and 11). No concrete deterioration was noted on the control riser or outlet endwall. The interior of the outlet conduit was not inspected because of partial inundation and noxious conditions attributed to the stagnant pool at the outlet (see Photograph 11). The stoplogs were in place and functioning as designed.

d. Reservoir Area. The general area surrounding Meadow Grounds Lake is comprised of moderate to steep, heavily forested slopes (see Photograph 1).

e. Downstream Channel. The channel downstream of Meadow Grounds Lake to about one-half mile from the dam is relatively flat and heavily vegetated. In the next two miles, the valley becomes very steep and narrow. No dwellings are located within the first 2-1/2 miles; however,

within the next mile to its confluence with Big Cove Creek, four residential dwellings are located. At least three of the dwellings are sufficiently close to the stream such that they could possibly be affected by flows associated with a failure of the dam (estimated population 9 to 12). Consequently, the hazard classification of the facility is considered to be high.

3.2 Evaluation.

The overall condition of the facility is considered to be good. Considerable seepage and poorly drained areas were observed immediately downstream from the embankment toe. A remedial drain has been installed; however, its effectiveness appears inadequate. Drainage and seepage conditions should be reevaluated and remedial measures implemented. The observed conditions are not presently considered serious with respect to embankment stability.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

Meadow Grounds Dam is essentially a self-regulating facility. Excess inflows are automatically discharged through the spillway located at the right abutment. The outlet conduit is generally used only for the purpose of drawing down the reservoir with flow being manually controlled via stoplogs set in grooves within the control tower riser. The top stoplog is set 1/2-foot above normal pool such that under high flows the outlet conduit begins to discharge automatically.

The PFC is currently developing a formal "Operation and Maintenance Manual" for Meadow Grounds Dam that will establish both routine and emergency operating procedures.

4.2 Maintenance of Dam.

Currently, maintenance of the dam is performed informally on an as-needed basis. The proposed "Operation and Maintenance Manual" will establish formal procedures and guidelines for all maintenance work. The manual will also include a formal maintenance checklist covering the entire facility.

4.3 Maintenance of Operating Facilities.

See Section 4.2 above.

4.4 Warning System.

Emergency plans are currently being developed for all PFC dams. A standard format is being incorporated into the "Operation and Maintenance Manual." A review of the procedures indicates possible deficiencies in the plan which include the lack of:

a. A definite procedure to notify downstream residents of a possible emergency situation.

b. Provisions for an alternative means of communication in the event telephone lines become inoperative.

c. Provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

4.5 Evaluation.

A formal manual establishing operation and maintenance procedures is currently being developed (a preliminary draft is available) by the PFC specifically for this facility. The manual will also contain procedures for operation of the facility during a flood emergency; however, consideration should be given to modifying any emergency plan in accordance with, but not limited to, the items listed in Section 4.4, herein.

SECTION 5
HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

Calculations contained in PFC files indicate that the hydrologic and hydraulic design of Meadow Grounds Dam was based on the Pennsylvania "C" Curve along with procedures and guidelines contained in the texts, "Design of Small Dams" by the U. S. Bureau of Reclamation, and "Handbook of Hydraulics" by King and Brater.

The data indicates that the spillway design flow from the "C" Curve is 1100 csm.

5.2 Experience Data.

Daily records of reservoir levels and/or spillway discharges are not available.

5.3 Visual Observations.

On the date of inspection, no conditions were observed that would indicate the spillway and outlet system would not perform satisfactorily during a flood event within the limits of its design capacity.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix C.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with the procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Meadow Grounds Dam is the Probable Maximum Flood (PMF). That is, based on

the relative size (intermediate), and the hazard potential (high) of the dam, the facility is required to have sufficient spillway and storage capabilities to safely discharge the PMF without embankment overtopping.

b. Results of Analysis. Meadow Grounds Dam was evaluated under near normal operating conditions. That is, the reservoir was initially at its normal pool or spillway elevation of 1495.3 feet, with the spillway weir discharging freely. However, the usually discharging outlet conduit was assumed to be non-functional for the purpose of analysis. In any event, the flow capacity of the outlet conduit is not such that it would significantly increase the total discharge capabilities of the facility. The spillway is a free overfall, concrete, trapezoidal-shaped weir that discharges into an open channel. A backwater curve was computed using the HEC-2 Computer Program to ascertain the effects of tailwater on the spillway discharges. All pertinent engineering calculations relative to the evaluation of this facility are provided in Appendix C.

Overtopping analysis (using the Modified HEC-1 Computer Program) indicated that the discharge/storage capacity of Meadow Grounds Dam can accommodate only about 92 percent of the PMF (SDF) prior to overtopping of the embankment (Appendix C, Summary Input/Output Sheets, Sheet E). The peak PMF inflow of approximately 7150 cfs was greatly attenuated by the discharge/storage capabilities of the dam and reservoir such that the resulting peak PMF outflow was about 5090 cfs (Summary Input/Output Sheets, Sheets D and E). Under the PMF, the embankment will be overtopped for approximately 2.5 hours, with a maximum depth of inundation of about 0.3 feet above the low top of dam elevation of 1501.7 feet (Summary Input/Output Sheets, Sheet E).

5.6 Spillway Adequacy.

Although Meadow Grounds Dam cannot accommodate its SDF (the PMF), the possible downstream consequences of embankment failure due to overtopping were not evaluated. Breaching analysis of the dam was not performed in accordance with ETL-1110-2-234, since the facility can safely pass a flood of at least 1/2 PMF magnitude. Since Meadow Grounds Dam cannot accommodate a PMF-size flood, its spillway is considered to be inadequate, but not seriously inadequate.

SECTION 6
EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Embankment. Based on observations made during the visual inspection, the embankment is considered to be in good condition. The facility is well maintained and no evidence of sloughing, erosion or excessive settlement was observed. Seepage and swamp-like conditions, however, exist immediately downstream of the embankment toe, particularly along the left abutment.

Seepage became apparent during reservoir filling and a remedial drain was installed although its performance appears questionable. The seepage is presently not considered a threat to the structural stability of the embankment; nevertheless, the seepage and drainage conditions observed should be evaluated and remedial measures taken to effectively collect and discharge the resulting flow from the embankment area. Seepage close to the embankment-abutment contact should be specifically addressed in future inspections to determine if it is encroaching onto the embankment. If so, appropriate remedial measures should be undertaken.

b. Appurtenant Structures.

1. Spillway. The spillway appears to be structurally well designed and currently in good condition. No evidence of concrete deterioration was observed.

2. Outlet Works. Visible portions of the intake tower and outlet conduit were found to be in good condition. The outlet conduit was not entered due to partial inundation and noxious conditions attributed to stagnant water ponded at the outlet.

6.2 Design and Construction Techniques.

No formal design reports are available, however, calculations contained in PFC files indicate a majority of the design was based on procedures and guidelines contained in the reference "Design of Small Dams" by the U. S. Bureau of Reclamation. Except for provisions to control seepage through and around the abutments and provide efficient downstream drainage, the facility appears adequately designed in accordance with accepted modern engineering practices.

It is noted also that compliance to contract specifications (particularly embankment zoning) were largely based

on the judgement of the resident engineer and no laboratory or field testing was apparently utilized. The procedure is questionable in that the effectiveness of the zoning can be verified only after several years of embankment performance.

6.3 Past Performance.

According to Pennsylvania Fish Commission personnel, the facility has operated virtually problem free with the exception of the seepage as previously discussed.

6.4 Seismic Stability.

The dam is located within Seismic Zone No. 1 and is thus subject to minor earthquake induced dynamic forces. It is believed that the static stability of the structure is sufficient to withstand such forces; however, no calculations and/or investigations were performed to confirm this belief.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Assessment.

a. Based on the visual inspection and hydrologic/hydraulic analysis, the facility is considered to be in good condition.

The size classification of the facility is intermediate and its hazard classification is considered to be high. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility is the Probable Maximum Flood (PMF). Results of the hydrologic and hydraulic analysis indicate the facility will pass and/or store about 92 percent of the PMF prior to embankment overtopping. Consequently, the spillway is assessed as being inadequate, but not seriously inadequate.

Deficiencies noted by the inspection team were confined to seepage along the abutment-embankment contact (particularly along the left abutment) and poorly drained conditions downstream of the outlet conduit.

b. Adequacy of Information. The available data are considered sufficient to make a reasonable assessment of the facility.

c. Urgency. It is suggested that the recommendations listed below be implemented as soon as possible.

d. Necessity for Additional Investigations. No additional investigations are currently deemed necessary.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner:

a. Evaluate the outlet works channel and take necessary remedial measures to provide unimpeded discharge through the channel.

b. Accurately map the seepage locations at the embankment-abutment contact and immediately downstream of the embankment and design an effective drainage system to eliminate observed ponding and swamp-like conditions.

c. Assess the seepage, particularly at the embankment-abutment contact, during all future inspections to determine if it is encroaching onto the embankment, and if so, take further appropriate remedial measures.

d. Reevaluate and revise the present standard flood emergency procedures in accordance with, but not limited to, the following items:

1. Include a definite procedure of notifying downstream residents of a possible emergency.

2. Provide for an alternate means of communication in the event telephone lines become inoperative.

3. Provide for around-the-clock surveillance of the facility during periods of unusually heavy precipation.

APPENDIX A

CHECK LIST - ENGINEERING DATA

NAME OF DAM: Meadow Grounds Dam

NDI#: PA-00185 PENNDER# : 29-32

CHECK LIST
ENGINEERING DATA
PHASE I

ITEM	REMARKS NDI# PA - 00185
PERSONS INTERVIEWED AND TITLE	E. Jon Grindall - Senior Project Engineer, Pennsylvania Fish Commission.
REGIONAL VICINITY MAP	See Figure 2 and Appendix G.
CONSTRUCTION HISTORY	Designed (1961) and constructed (1962-1964) by PFC personnel.
AVAILABLE DRAWINGS	Complete set of construction drawings available from PennDER and PFC files.
TYPICAL DAM SECTIONS	Figure 6, Appendix F.
OUTLETS: PLAN DETAILS DISCHARGE RATINGS	Figure 7, Appendix F. Figure 7, Appendix F. Not available.

ITEM	REMARKS NDI# PA - 00185
SPILLWAY: PLAN SECTION DETAILS	 Figure 3, Appendix F. Figure 5, Appendix F. Figure 8, Appendix F.
OPERATING EQUIPMENT PLANS AND DETAILS	Stop log mechanism - Figure 7, Appendix F.
DESIGN REPORTS	No formal report. Design calculations available from PFC. Good review report by PennDER for issuance of permit.
GEOLOGY REPORTS	No formal geology report. A brief subsurface report is available from PFC files which discusses results of drilling and pressure testing (dated August 12, 1959).
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	 Available from PFC files. None available. None available.
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	 Borings presented on Figure 4, Appendix F. Drilled by Boring, Soils and Testing of Harrisburg, Pennsylvania. - None available. - None available, except for hydraulic pressure tests during drilling.

ITEM	REMARKS NDI# PA - 00185
BORROW SOURCES	Figure 2, Appendix F indicates borrow sources were within reservoir area.
POST CONSTRUCTION DAM SURVEYS	None performed.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Dye study was conducted in May, 1964 when seepage became apparent during reservoir filling. Tests briefly discussed in correspondence contained in PennDER files.
HIGH POOL RECORDS	Not known.
MONITORING SYSTEMS	None.
MODIFICATIONS	Toe drain along left abutment modified in 1964 after seepage was noted. Ditches reportedly dug by hand as area was too wet for mobilization of equipment.

ITEM	REMARKS	NDI# PA - 00185
PRIOR ACCIDENTS OR FAILURES	None, except for seepage problems.	
MAINTENANCE: RECORDS MANUAL	A formal "Operations and Maintenance Manual" has been drafted and is being reviewed for finalization.	
OPERATION: RECORDS MANUAL	See "Maintenance" above.	
OPERATIONAL PROCEDURES	Facility is self-regulating and would be drawn down only for repairs or fishery management.	
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	A flood emergency operations procedure is included in the draft of the "Operation and Maintenance Manual".	
MISCELLANEOUS		

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

NDI ID # PA-00185
PENN DER ID # 29-32

SIZE OF DRAINAGE AREA: 3.2 square miles

ELEVATION TOP NORMAL POOL: 1495.3 STORAGE CAPACITY: 3130 acre-feet

ELEVATION TOP FLOOD CONTROL POOL: -- STORAGE CAPACITY: --

ELEVATION MAXIMUM DESIGN POOL: -- STORAGE CAPACITY: --

ELEVATION TOP DAM: 1501.7 STORAGE CAPACITY: 4670 acre-feet

SPILLWAY DATA

CREST ELEVATION: 1495.3 (Based on field measurements from benchmark on right abutment, spike in tree)

TYPE: free overfall concrete, trapezoidal shaped weir

WIDTH: 67 feet

SPILLOVER LOCATION: cut in rock about 200 feet from right abutment

NUMBER AND TYPE OF GATES: none

OUTLET WORKS

TYPE: 4-foot square (I.D.) concrete conduit with control tower riser.

LOCATION: near centerline of dam

ENTRANCE INVERTS: approximately 1464 feet

EXIT INVERTS: approximately 1463 feet

EMERGENCY DRAWDOWN FACILITIES: stoplogs in control tower

HYDROMETEOROLOGICAL GAGES

TYPE: none

LOCATION: --

RECORDS: --

MAXIMUM NON-DAMAGING DISCHARGE: Not known

APPENDIX B

CHECK LIST - VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Meadow Grounds Dam STATE Pennsylvania COUNTY Fulton

NDI# PA - 00185 PENNDER# 29-32

TYPE OF DAM zoned earth SIZE intermediate HAZARD CATAGORY high

DATE(S) INSPECTION 10 August 1979 WEATHER clear TEMPERATURE 75° @ noon

POOL ELEVATION AT TIME OF INSPECTION 1495.3 M.S.L.

TAILWATER AT TIME OF INSPECTION none M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	OTHERS
B. Mihalcin	E. Jon Grindall (Senior Project Engineer)	
D. Bonk	C. Buell (District II Facilities Manager)	
W. Veon	D. O'Neil (Maintenance Superintendent)	

RECORDED BY B. Mihalcin

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 00185
SURFACE CRACKS	None observed.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Good alignment both vertically and horizontally.
RIPRAP FAILURES	None observed. Riprap is durable hand-placed sandstone.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 00185
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	None on embankment. Area immediately downstream of embankment (particularly along left abutment) is swamp-like from seepage and poor drainage.
ANY NOTICEABLE SEEPAGE	Considerable seepage around left abutment at and below elevation 1488 about 7 feet below normal pool. Lesser amount along right abutment at embankment-abutment contact beginning approximately 2 feet below normal pool.
STAFF GAGE AND RECORDER	None.
DRAINS	Toe drains are provided, but the exits were submerged at time of inspection.
OTHER	A remedial drain was installed just after reservoir filling when seepage surfaced along the contact area of the left abutment.

OUTLET WORKS

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 00185
INTAKE STRUCTURE	Concrete drop inlet controlled by stoplogs. In good condition.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	Not entered due to submergence and noxious odor. Should open downstream channel to permit drainage and inspect conduit (possibly need air supply).
OUTLET STRUCTURE	Endwall in good condition. No cracking or other concrete deterioration observed.
OUTLET CHANNEL	Flat, poorly drained channel. Old beaver ponds apparently obstructing drainage and causing ponding. Should open channel to facilitate flow.
GATE(S) AND OPERATIONAL EQUIPMENT	Stoplog mechanism in control tower. In good condition.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 00185
TYPE AND CONDITION	Trapezoidal-shaped concrete chute cut into rock about 200 feet to right of embankment. Concrete in excellent condition.
APPROACH CHANNEL	Clear and unobstructed.
SPILLWAY CHANNEL AND SIDEWALLS	Concrete lined sidewalls and overflow weir in excellent condition.
STILLING BASIN PLUNGE POOL	Unobstructed and submerged.
DISCHARGE CHANNEL	Trapezoidal-shaped riprap lined channel for about 100 feet downstream of spilling basin in good condition. Discharge then empties into steep, narrow gulley that enters Roaring Run about 500 feet downstream of dam.
BRIDGE AND PIERS	None.
EMERGENCY GATES	None.

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 00185
TYPE AND CONDITION	N/A
APPROACH CHANNEL	N/A
OUTLET STRUCTURE	N/A
DISCHARGE CHANNEL	N/A

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 00185
MONUMENTATION SURVEYS	Two bench marks were observed which consists of spikes in mature trees on either abutment. The right abutment bench mark of 1502.0 was used as the reference datum for field measurements.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	

ITEM	OBSERVATIONS AND/OR REMARKS NDI# PA - 00185
SLOPES: RESERVOIR	Slopes surrounding the reservoir are moderate to steep and heavily forested.
SEDIMENTATION	None observed.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Relatively flat immediately downstream of dam. Heavily vegetated, but no significant obstructions observed that would cause discharge problems with spillway.
SLOPES: CHANNEL VALLEY	Channel relatively flat for about 2500 feet from dam, then very steep. Valley walls steep.
APPROXIMATE NUMBER OF HOMES AND POPULATION	Three (3) homes are located along Roaring Run about 2½ miles from the dam that could be affected by large discharges associated with a dam failure. Estimated population is approximately 9 - 12.

APPENDIX C

HYDROLOGY AND HYDRAULICS

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.

d Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevations of failure hydrographs for each location.

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-30-79 PROJ. NO. 78-617-185

CHKD. BY DJS DATE 9-1-79 SHEET NO. 1 OF 18

gai CONSULTANTS,
Engineers • Geologists • Planners
Environmental Specialists

DAM STATISTICS

HEIGHT OF DAM ≈ 39 FT (FIELD MEASURED)
(MEASURED FROM OUTLET INVERT
EL 1463.1 TO LOW TOP OF DAM EL 1501.7)

MAXIMUM POOL STORAGE CAPACITY ≈ 4670 (FROM HEC-1)
@ LOW TOP OF DAM

NORMAL POOL STORAGE CAPACITY ≈ 3130 AC-FT (SEE NOTE 1)

DRAINAGE AREA ≈ 3.2 SQ.MI. [PLANIMETERED OFF USGS 7.5 MINUTE MEADOW GROUNDS, PA QUAD]

NOTE 1: NORMAL POOL STORAGE CAPACITY OBTAINED FROM "DAMS, RESERVOIRS, AND NATURAL LAKES", WATER RESOURCES BULLETIN NO. 5, COMMONWEALTH OF PENNSYLVANIA, DEPARTMENT OF FORESTS AND WATERS HARRISBURG, PENNSYLVANIA, 1970. THE ACTUAL REPORTED VALUE WAS 1020 MILLION GALLONS.

DAM CLASSIFICATION

DAM SIZE - INTERMEDIATE (REF 1, TABLE 1)
(DUE TO STORAGE CAPACITY)

HAZARD CLASSIFICATION - HIGH (FIELD OBSERVATI

REQUIRED SDF - PMF (REF 1, TABLE 3)

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-30-79 PROJ. NO. 73-617-185

CHKD. BY DJS DATE 9-1-79 SHEET NO. 2 OF 18

gai CONSULTANTS,
Engineers • Geologists • Planners
Environmental Specialists

HYDROGRAPH PARAMETERS

LENGTH OF LONGEST WATERCOURSE ≈ 4.2 MI

L_{CA} ≈ 1.7 MI (MEASURED ALONG THE LONGEST WATERCOURSE FROM THE DAM CREST TO THE BASIN CENTROID)

NOTE 2: VALUES OF L AND L_{CA} ARE MEASURED FROM THE USGS 7.5 MINUTE MEADOW GROUNDS, PA QUAD. ALL HYDROGRAPH VARIABLES ARE DEFINED IN REF 2, IN THE SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH".

C_t ≈ 1.9
C_p ≈ 0.70

[SUPPLIED BY COE; ZONE 31 POTOMAC RIVER BASIN (WEST OF MONOCACY RIVER)]

t_p = SNYDER'S STANDARD LAG ≈ $1.9 (L \times L_{CA})^{0.3}$

$\therefore \quad t_p \approx 1.9 (4.2 \times 1.7)^{0.3} \approx 3.43$ HRS

RESERVOIR SURFACE AREAS

SURFACE AREA (SA) @ NORMAL POOL EL 1495.3 ≈ 206 AC

NOTE 3: NORMAL POOL EL 1495.3 FT OBTAINED FROM FIELD MEASUREMENTS (RELATIVE TO EL 1502.0 BM DATUM AS MARKED ON TREE ON RIGHT ABUTMENT). NORMAL POOL SA OBTAINED FROM REFERENCE IN NOTE 1, SHEET 1.

SA @ EL 1500 FT ≈ 257 AC

SA @ EL 1520 FT ≈ 419 AC

[PLANIMETERED OFF USGS 7.5 MINUTE MEADOW GROUNDS, PA QUAD]

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-30-79 PROJ. NO. 78-617-185

CHKD. BY DJS DATE 9-1-79 SHEET NO. 3 OF 18

gai CONSULTANTS,
Engineers • Geologists • Planne
Environmental Specialists

LOW TOP OF DAM ELEVATION ≈ 1501.7 FT (FIELD MEASUREMENTS)

RATE OF SA INCREASE PER FOOT OF RESERVOIR RATE:

$$\Delta SA/\Delta H \approx (419-257)\,AC/(1520-1500)\,FT \approx 8.1\ AC/FT$$

$$\therefore\ SA\ @\ EL\ 1501.7\ FT \approx 257\ AC + [8.1\ AC/FT\ (1501.7-1500)\,FT]$$
$$\approx 271\ AC$$

RESERVOIR ELEVATION @ "0" STORAGE

NORMAL POOL VOLUME ≈ ⅓ HA ≈ 3130 AC-FT (CONIC METHOD)

SA @ NORMAL POOL ≈ 206 AC

$$\therefore\ H \approx (3130\ AC\text{-}FT)(3)/(206\ AC) \approx 45.6\ FT$$

ZERO VOLUME ELEVATION ≈ 1495.3 FT - 45.6 FT ≈ 1449.7 FT

NOTE 4: ALTHOUGH THE ACTUAL DESIGN MINIMUM RESERVOIR ELEVATION IS ABOUT 1464.3 FT (APPENDIX F, FIGURE 7; ADJUSTED ELEVATION), IN ORDER TO COMPUTE AN ELEVATION - STORAGE RELATIONSHIP AND STILL MAINTAIN A STORAGE OF 3130 AC-FT @ EL 1495.3 FT, THE ABOVE COMPUTED "0" STORAGE ELEVATION MUST BE INPUT INTO THE HEC-1 COMPUTER PROGRAM.

RESERVOIR ELEVATION-STORAGE RELATIONSHIP

COMPUTED INTERNALLY BY THE HEC-1 PROGRAM BASED ON THE GIVEN ELEVATION VS SURFACE AREA INFORMATION (SEE SUMMARY INPUT / OUTPUT SHEETS).

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-30-79 PROJ. NO. 79-617-185

CHKD. BY DJS DATE 9-1-79 SHEET NO. 4 OF 18

gai CONSULTANTS, Inc.
Engineers • Geologists • Planners
Environmental Specialists

PMP CALCULATIONS

- APPROXIMATE RAINFALL INDEX = 24 IN (REF 3, FIG 1)
  (CORRESPONDING TO A DURATION OF 24 HR AND AN AREA OF 200 SQ MI, LOCATED IN SOUTHCENTRAL PENNSYLVANIA)

- DEPTH - AREA - DURATION ZONE #6 (REF 3, FIG 1)

- DRAINAGE AREA ≈ 3.2 SQ MI ⇒ ASSUME THAT DATA CORRESPONDING TO A 10 SQ MI AREA IS REPRESENTATIVE OF THIS BASIN:

DURATION (HR)	PERCENT OF INDEX RAINFALL (%)
6	113
12	124
24	132
48	143

- HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AS WELL AS FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALLER BASIN) CORRESPONDING TO A DA ≈ 3.2 SQ MI (< 10 SQ MI) ≈ 0.90 (REF 4, PG 49)

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-30-79 PROJ. NO. 78-617-185

CHKD. BY DJS DATE 9-1-79 SHEET NO. 6 OF 18

gai CONSULTANTS,
Engineers • Geologists • Planner
Environmental Specialists

- THE SPILLWAY IS A FREE OVERFALL, CONCRETE, TRAPEZOIDAL-SHAPED WEIR STRUCTURE THAT DISCHARGES INTO AN OPEN CHANNEL. FLOW OVER THE WEIR CAN BE DEFINED BY:

$$Q_w = C L H^{3/2} \qquad \text{(REF 5, PG 5.3)}$$

WHERE Q_w = DISCHARGE OVER WEIR, IN CFS;
L = LENGTH OF WEIR CREST $\approx$ 67 FT;
H = HEIGHT OF RESERVOIR ABOVE SPILLWAY CREST EL 1495.3 FT, ASSUMED DESIGN HEAD (H_o) $\approx$ 6.4 FT;
C = DISCHARGE COEFFICIENT $\approx$ 3.3 (REF 5, PG 5-4 BASED ON WEIR GEOMETRY)

- DISCHARGE ALONG THE INCLINED WINGWALLS WILL BE ASSUMED TO OCCUR AT THE SAME VELOCITY AS THE DISCHARGE OVER THE WEIR. THEREFORE WINGWALL FLOW CAN BE DEFINED BY THE CONTINUITY EQUATION:

$$Q_{ww} = v_w A_{ww} = (Q_w / A_w) A_{ww} \qquad \text{(REF 5, PG 3-4}$$

WHERE Q_{ww} = DISCHARGE OVER THE INCLINED WINGWALLS, IN CFS;
v_w = VELOCITY OF WEIR DISCHARGE, IN FPS;
A_{ww} = FLOW AREAS ABOVE INCLINES WINGWALLS IN FT^2; AND
A_w = FLOW AREA ABOVE WEIR, IN FT^2.

- APPROACH CHANNEL LOSSES @ DESIGN FLOW:

a) APPROXIMATE APPROACH CHANNEL LENGTH = 80 FT;
APPROACH CHANNEL WIDTH $\approx$ 57 FT (BOTTOM WIDTH);

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-31-79 PROJ. NO. 79-617-185

CHKD. BY DJS DATE 9-1-79 SHEET NO. 7 OF 18

gai CONSULTANTS, I
Engineers • Geologists • Planners
Environmental Specialists

RIGHTSIDE OF APPROACH CHANNEL VARIES FROM ABOUT 13.3 FT ABOVE THE CHANNEL @ THE WEIR, TO ABOUT 0 FT @ THE APPROACH ENTRANCE. SLOPE OF RIGHTSIDE ≈ 2H TO 1V

LEFT SIDE OF APPROACH CHANNEL VARIES FROM ABOUT 9.2 FT ABOVE THE CHANNEL @ THE WEIR, TO ABOUT 0 FT @ THE APPROACH ENTRANCE. SLOPE OF LEFTSIDE ≈ 2H TO 1V

∴ @ RESERVOIR EL 1501.7 FT (LOW TOP OF DAM) THE MAXIMUM APPROACH CHANNEL DEPTH = FOREBAY DEPTH + HEAD OVER WEIR CREST = 2.5 FT + 6.4 FT ≈ 8.9 FT

⇒ AVERAGE APPROACH CHANNEL FLOW AREA ≈ A_a

$$A_a \approx (57\text{FT} \times 8.9\text{FT}) + 2[\tfrac{1}{2}(8.9\text{FT} \times 2)(8.9\text{FT})]$$
$$A_a \approx 666\ \text{FT}^2$$

b) INITIAL ESTIMATE OF DISCHARGE @ EL 1501.7 FT

$$Q_W \approx (3.9)(67\text{FT})(6.4\text{FT})^{3/2} \approx 4120\ \text{CFS}$$

$$A_W \approx (6.4\text{FT} \times 67\text{FT}) \approx 429\ \text{FT}^2$$

$$\therefore Q_{WW} \approx \left(4120\ \text{CFS}/429\ \text{FT}^2\right) \times 2\left[\tfrac{1}{2}(6.4\text{FT} \times 2)(6.4\text{F}\right.$$
$$\approx 790\ \text{CFS}$$

$$\Rightarrow Q_{TOTAL} \approx 4120\ \text{CFS} + 790\ \text{CFS} \approx 4910\ \text{CFS}$$

c) AVERAGE APPROACH CHANNEL VELOCITY ≈ Q_{TOTAL}/A_a

$$V_a \approx 4910\ \text{CFS}/666\ \text{FT}^2 \approx 7.4\ \text{FPS}$$

gai CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

$\Rightarrow$ AVERAGE APPROACH VELOCITY HEAD = $h_a \approx V_a^2/2g$

$h_a \approx (7.4 \text{ FPS})^2/2g \approx 0.85 \text{ FT}$

ASSUME THAT THE APPROACH CHANNEL ENTRANCE LOSS $\approx 0.1\, h_a$ (REF 4, PG 379) $\Rightarrow 0.09$ FT

d) APPROACH CHANNEL FRICTION LOSS = $h_f \approx \left[V_a n/1.49 R_h^{2/3}\right]^2 \times L_c$

WHERE L_c = LENGTH OF APPROACH CHANNEL ≈ 80 FT (FIELD MEASURED);
n = MANNINGS ROUGHNESS COEFFICIENT ≈ 0.04 (REF 7, PG 112; EXCAVATED CHANNEL COBBLE BOTTOM AND CLEAN SIDES);
R_h = HYDRAULIC RADIUS = FLOW AREA/WETTED PERIMETER
FLOW AREA = $A_a \approx 666 \text{ FT}^2$, AVERAGE RIGHT SIDEWALL PARTIAL PERIMETER ≈ 13.2 FT, AVERAGE LEFT SIDEWALL PARTIAL PERIMETER ≈ 10.3 FT, TOTAL WETTED PERIMETER $\approx 57 \text{ FT} + 13.2 \text{ FT} + 10.3 \text{ FT} \approx 80.5 \text{ FT} \Rightarrow R_h \approx 666 \text{ FT}^2/80.5 \text{ FT} \approx 8.3$ FT

$\therefore h_f \approx (80 \text{ FT}) \left[(7.4 \text{ FPS})(0.04)/(1.49)(8.3 \text{ FT})^{2/3}\right]^2 \approx 0.19 \text{ FT}$

$\therefore$ TOTAL APPROACH CHANNEL LOSS $\approx 0.09 \text{ FT} + 0.19 \text{ FT} \approx 0.28 \text{ FT}$

$\Rightarrow$ ACTUAL EFFECTIVE HEAD $\approx 6.4 \text{ FT} - 0.28 \text{ FT} \approx 6.12 \text{ FT}$

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-31-79 PROJ. NO. 78-617-185

CHKD. BY DJS DATE 9-1-79 SHEET NO. 9 OF 18

gai CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

- CHECK FOR SUBMERGENCE EFFECTS :

DISCHARGE W/O SUBMERGENCE $\Rightarrow Q_W \approx (3.9)(67FT)(6.12FT)^{3/2}$
≈ 3950 CFS

$Q_{WW} \approx [3950\ CFS/(67FT \times 6.12FT)] \times [(2 \times 6.12FT)(6.12FT)]$
≈ 700 CFS

$\Rightarrow Q_{TOTAL} \approx 3950\ CFS + 700\ CFS \approx 4550\ CFS$

$\therefore$ TAILWATER ON THE SPILLWAY @ $Q \approx 4550$ CFS IS APPROXIMATELY @ EL 1497.8 (SHEET 10)

SINCE THE RESERVOIR LEVEL @ $Q \approx 4550$ CFS IS APPROXIMATELY @ EL 1501.7 $\Rightarrow h_d \approx 1501.7 - 1497.8 \approx 3.9$ FT (h_d = DIFFERENCE BETWEEN RESERVOIR AND TAILWATER LEVELS)

$\therefore h_d/H_e \approx 3.9/6.12 \approx 0.64$

$\Rightarrow$ CORRECTION TO DISCHARGE COEFFICIENT ≈ 0.99 ($= C_s/C$); ASSUMING THAT THE SUBMERGENCE RELATIONSHIP FOR AN OGEE-SHAPED WEIR IS REPRESENTATIVE FOR THIS TRAPEZOIDAL-SHAPED WEIR (REF 4, PG 392)

$\therefore C_s \approx (3.9)(0.99) \approx 3.76$

$\Rightarrow$ SPILLWAY CAPACITY : $Q_W \approx (3.76)(67FT)(6.12FT)^{3/2}$
≈ 3910 CFS

$Q_{WW} \approx [3910\ CFS/(67FT \times 6.12FT)] \times [(2 \times 6.12FT) \times (6.12FT)] \approx 700$ CFS

$\therefore Q_{TOTAL} \approx 3910\ CFS + 700\ CFS \approx 4510\ CFS$

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-31-79 PROJ. NO. 73-617-195

CHKD. BY DJS DATE 9-1-79 SHEET NO. 10 OF 18

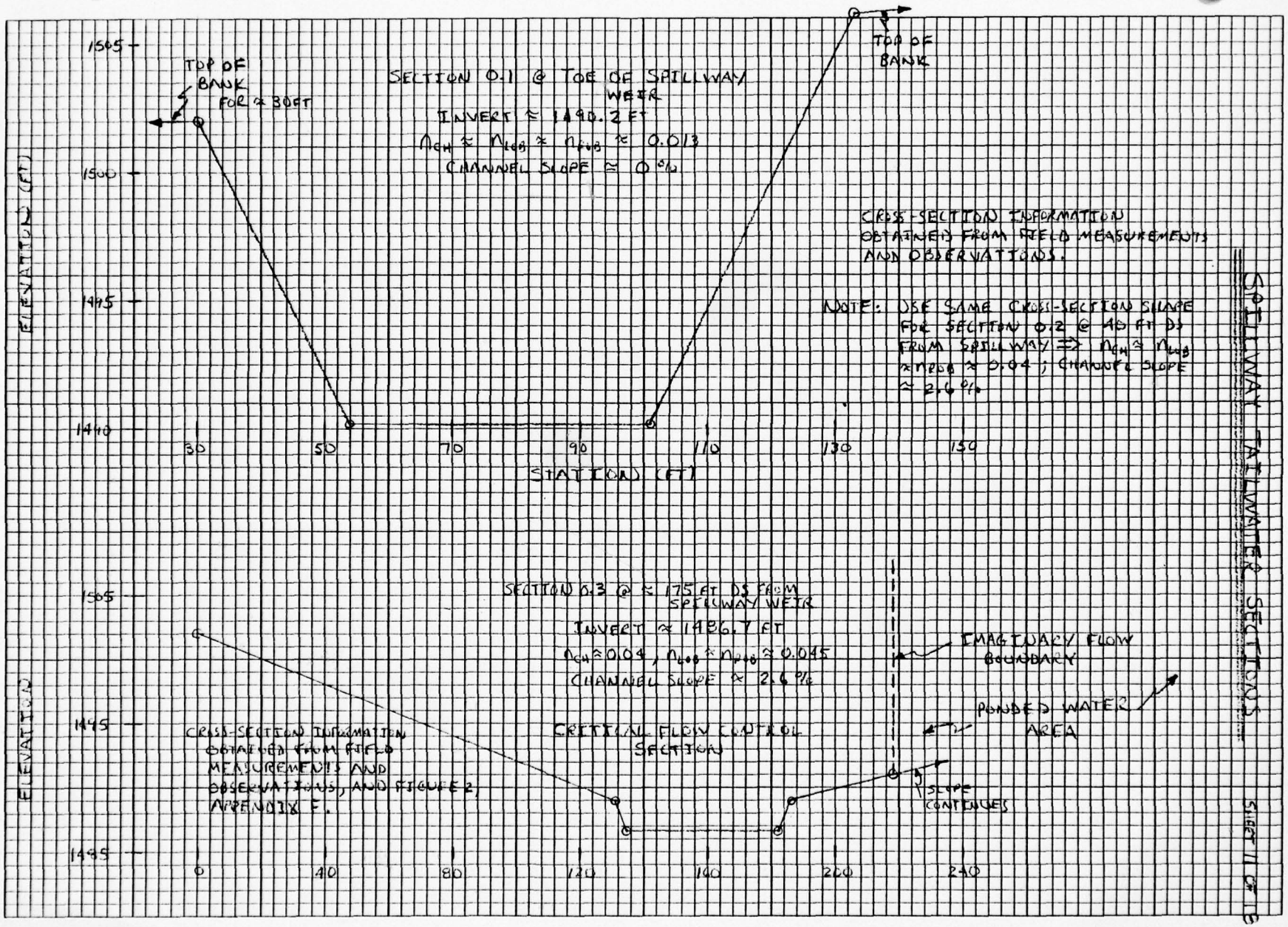
gai CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

TAILWATER RATING CURVE

DUE TO THE HEIGHT OF THE SPILLWAY CREST ABOVE THE DISCHARGE CHANNEL (ONLY ABOUT 5 FT), AND TO THE GRADIENT OF THE DISCHARGE CHANNEL (≈ 2.6%), A BACKWATER CURVE WAS COMPUTED TO ASCERTAIN THE EFFECTS OF TAILWATER ON SPILLWAY DISCHARGES. THE BACKWATER CURVE WAS CALCULATED VIA THE HEC-2 WATER SURFACE PROFILE COMPUTER PROGRAM*. HEC-2 COMPUTES BACKWATER BY THE STANDARD STEP METHOD (REF 7, PG 274-280), BASED ON CHANNEL CROSS-SECTION INFORMATION. THE SPECIFIC CROSS-SECTION DATA USED IS GIVEN ON SHEET 11. THE COMPUTATIONS WERE INITIATED AT AN APPARENT CONTROL SECTION, LOCATED ABOUT 175 FT DOWNSTREAM FROM THE SPILLWAY, BY THE ASSUMPTION OF CRITICAL DEPTH. CALCULATIONS PROCEEDED UPSTREAM TO SECTION 0.2 @ THE TOE OF THE STILLING BASIN, AND THEN TO SECTION 0.1 @ THE TOE OF THE WEIR. THE RATING TABLE BELOW CORRESPONDS TO THE HEC-2 OUTPUT FOR SECTION 0.1:

ELEVATION (FT)	Q (CFS)	ELEVATION (FT)	Q (CFS)
1490.2	0	1499.8	7000
1492.5	500	1500.5	8000
1493.6	1000	1501.2	9000
1495.1	2000	1501.9	10000
1496.3	3000	1502.4	11000
1497.3	4000	1503.1	12000
1498.2	5000	1503.7	13000
1499.0	6000		

* HEC-2 WATER SURFACE PROFILES (USER'S MANUAL), HYDRAULIC ENGINEERING CENTER, U.S. ARMY CORPS OF ENGINEERS, DAVIS, CALIFORNIA, NOV. 19


SPILLWAY TAILWATER SECTIONS
SHEET 11 OF 15
SECTION 0.1 @ TOE OF SPILLWAY WEIR
INVERT ≈ 1490.2 FT
$n_{CH} \approx n_{LOB} \approx n_{ROB} \approx 0.013$
CHANNEL SLOPE ≈ 0 %
TOP OF BANK FOR ≈ 30 FT
TOP OF BANK
CROSS-SECTION INFORMATION OBTAINED FROM FIELD MEASUREMENTS AND OBSERVATIONS.
NOTE: USE SAME CROSS-SECTION SHAPE FOR SECTION 0.2 @ 40 FT DS FROM SPILLWAY ⇒ $n_{CH} \approx n_{LOB} \approx n_{ROB} \approx 0.04$; CHANNEL SLOPE ≈ 2.6 %
ELEVATION (FT)
STATION (FT)
1505
1500
1495
1490
30
50
70
90
110
130
150
SECTION 0.3 @ ≈ 175 FT DS FROM SPILLWAY WEIR
INVERT ≈ 1486.7 FT
$n_{CH} \approx 0.04$, $n_{LOB} \approx n_{ROB} \approx 0.045$
CHANNEL SLOPE ≈ 2.6 %
IMAGINARY FLOW BOUNDARY
PONDED WATER AREA
CRITICAL FLOW CONTROL SECTION
SLOPE CONTINUES
CROSS-SECTION INFORMATION OBTAINED FROM FIELD MEASUREMENTS AND OBSERVATIONS, AND FIGURE 2, APPENDIX E.
ELEVATION
1505
1495
1485
0
40
80
120
160
200
240

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 9-31-79 PROJ. NO. 78-617-195

CHKD. BY DJS DATE 9-1-79 SHEET NO. 12 OF 18

gai CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

SPILLWAY RATING CURVE

AS THE HEAD ABOVE THE WEIR BECOMES SMALL, THE ROUGHNESS OF THE CREST AND THE CONTACT PRESSURE BETWEEN THE WATER AND THE CREST EXERT A LARGER INFLUENCE ON DISCHARGES. THAT IS, THE C-VALUES DECREASE WITH DECREASING HEAD. THE OPPOSITE TREND OCCURS FOR HIGHER HEADS. THEREFORE, ASSUME THAT THE DISCHARGE COEFFICIENT - HEAD RELATIONSHIP FOR THE TRAPEZOIDAL-SHAPED WEIR CAN BE REPRESENTED BY THAT FOR AN OGEE-SHAPED WEIR (REF 4, PG 379, FIG 250). THE MAXIMUM HEAD PRIOR TO OVERTOPPING OF THE EMBANKMENT IS ABOUT 6.4 FT, WHICH IS ASSUMED TO BE THE DESIGN HEAD (H_o). THE DESIGN DISCHARGE COEFFICIENT (C_o) WILL BE ASSUMED TO EQUAL 3.8 (SHEET 6).

ALL DISCHARGES OVER THE WEIR ARE DEFINED BY THE $Q_w = CLH^{3/2}$ RELATIONSHIP, AND ALL DISCHARGES OVER THE INCLINED WINGWALLS ARE DEFINED BY THE $Q_{ww} = (Q_w/A_w) \times A_{ww}$ RELATIONSHIP AS GIVEN ON SHEET 6. THE HEAD OVER THE WEIR WILL BE ADJUSTED TO ACCOUNT FOR APPROACH CHANNEL LOSSES BY PROPORTIONING THE COMPUTED LOSS OF 0.29 FT AT EL 1501.7 FT. ALSO, SUBMERGENCE EFFECTS WILL BE CONSIDERED ACCORDING TO THE TAILWATER RATING TABLE ON SHEET 10.

SPILLWAY RATING CURVE IS GIVEN ON SHEETS 13 AND 14

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM
BY WJV DATE 8-31-79 PROJ. NO. 79-617-195
CHKD. BY DJS DATE 9-1-79 SHEET NO. 13 OF 18

- SPILLWAY RATING TABLE : (TABLE CONTINUED ON SHEET 14)

RESERVOIR ELEVATION (FT)	① H (FT)	H/H₀ (FT/FT)	② C/C₀	③ C	④ ESTIMATED APPROACH LOSS (FT)	⑤ EFFECTIVE HEAD: Hₑ (FT)	INITIAL ESTIMATES ⑥ Qw (CFS)	⑦ Aw (FT²)	⑧ Aww (FT²)	⑨ Qww (CFS)
1495.3	0	-	-	-	-	0	0	-	-	0
1496.0	0.7	0.11	0.82	3.12	0.03	0.67	110	45	1	0
1497.0	1.7	0.27	0.87	3.31	0.08	1.62	460	109	5	20
1498.0	2.7	0.42	0.90	3.42	0.12	2.58	950	173	13	70
1499.0	3.7	0.58	0.94	3.57	0.16	3.54	1590	237	25	170
1500.0	4.7	0.73	0.96	3.65	0.20	4.50	2330	302	41	320
1501.0	5.7	0.89	0.99	3.76	0.25	5.45	3210	365	59	520
1501.7	6.4	1.0	1.0	3.8	0.28	6.12	3850	410	75	700
1502.0	6.7	1.05	1.01	3.84	0.29	6.41	4180	429	82	800
1503.0	7.7	1.20	1.03	3.91	0.34	7.36	5230	493	108	1150
1504.0	8.7	1.36	1.04	3.95	0.38	8.32	6350	557	136	1550
1505.0	9.7	1.52	1.06	4.03	0.43	9.27	7620	621	165	2020
1506.0	10.7	1.67	1.07	4.07	0.47	10.23	8920	685	197	2570

① H = RESERVOIR ELEVATION - 1495.3 FT ;

② REF 4, PG 378, FIG 250, BASED ON H/H_0 ;

③ $C \approx 3.8 \times C/C_0$;

④ ESTIMATED LOSS $\approx H/H_0 \times 0.28$ FT ;

⑤ EFFECTIVE HEAD = $H_e \approx$ H - APPROACH LOSS ;

⑥ $Q_w \approx C \times (67FT) \times H_e^{3/2}$;

⑦ $A_w \approx 67FT \times H_e$;

⑧ $A_{ww} \approx 2 \times H_e^2$ BELOW EL 1502.0 FT, AND

$A_{ww} \approx [\frac{1}{2}(2H_e^2)] + \{[\frac{1}{2} \times 2 \times (6.7FT)^2] + [2 \times 6.7FT \times (H_e - 6.7FT)]\}$

ABOVE EL 1502.0 FT ;

⑨ $Q_{ww} \approx (Q_w/67H_e) \times A_{ww}$

GAI CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

SUBJECT DAM SAFETY INSPECTION

MEADOW GROUNDS DAM

BY WJV DATE 8-31-79 PROJ. NO. 78-617-195

CHKD. BY DJS DATE 9-1-79 SHEET NO. 14 OF 18

GEI CONSULTANTS, INC

Engineers • Geologists • Planners
Environmental Specialists

- SPILLWAY RATING TABLE : (TABLE CONTINUED FROM SHEET 13)

(10)	(11)		(12)	(13)	FINAL VALUES					
INITIAL ESTIMATE Q_T (CFS)	TW ELEVATION (FT)	h_d/H_e (FT/FT)	C_S/C	C_S	(14) Q_W (CFS)	A_W (FT^2)	A_{WW} (FT^2)	Q_{WW} (CFS)	Q_T (CFS)	RESERVOIR ELEVATION (FT)
0	1490.2	-	-	-	0	-	-	0	0	1495.3
110	1490.7	7.9	1.0	3.12	110	45	1	0	110	1496.0
480	1492.4	2.8	1.0	3.31	460	109	5	20	480	1497.0
1020	1493.6	1.7	1.0	3.42	950	173	13	70	1020	1498.0
1760	1494.7	1.2	1.0	3.57	1590	237	25	170	1760	1499.0
2650	1495.9	0.91	1.0	3.65	2330	302	41	320	2650	1500.0
3730	1497.0	0.73	1.0	3.76	3210	365	59	520	3730	1501.0
4550	1497.8	0.64	0.99	3.76	3810	410	75	700	4510	1501.7
4980	1498.2	0.59	0.99	3.80	4130	429	82	790	4920	1502.0
6380	1499.3	0.50	0.98	3.83	5120	493	108	1120	6240	1503.0
7900	1500.4	0.43	0.97	3.83	6160	557	136	1500	7660	1504.0
9640	1501.6	0.37	0.96	3.87	7320	621	165	1940	9260	1505.0
11490	1502.7	0.32	0.94	3.83	8400	685	197	2420	10820	1506.0

(10) $Q_T = Q_W + Q_{WW}$ (INITIAL ESTIMATES);

(11) TW ELEVATION INTERPOLATED FROM SHEET 10, BASED ON Q_T;

(12) C_S/C FROM REF 4, PG 382, FIG 254, BASED ON h_d/H_e;

(13) $C_S \approx C \times C_S/C$;

(14) $Q_W = C_S \times (67FT) \times H_e^{3/2}$; A_W, A_{WW}, Q_{WW}, Q_T ARE DEFINED AS ON SHEET 13.

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-31-79 PROJ. NO. 79-617-195

CHKD. BY DJS DATE 9-1-79 SHEET NO. 15 OF 18

gai CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

EMBANKMENT RATING CURVE

- LENGTH OF EMBANKMENT SUBMERGED VS RESERVOIR ELEVATION (BASED ON FIELD MEASUREMENTS):

RESERVOIR ELEVATION (FT)	EMBANKMENT LENGTH (FT)
1501.7	0
1501.8	40
1501.9	220
1502.0	500
1502.4	610
1502.6	690
1502.7	700
1503.0	710
1504.0	730
1505.0	750
1506.0	770

} BASED PARTIALLY ON 20H TO 1V SIDESLOPE OF LEFT ABUTMENT AS MEASURED FROM FIGURE 2, APPENDIX F.

- ASSUME THE EMBANKMENT ACTS LIKE A BROAD-CRESTED WEIR WHEN OVERTOPPED, W/ DISCHARGE DEFINED BY:

$$Q = CLH^{3/2} \qquad \text{(SHEET 6)}$$

WHERE L = LENGTH OF EMBANKMENT INUNDATED, IN FT;
C = DISCHARGE COEFFICIENT FOR EMBANKMENTS
= f (H/ℓ WHERE ℓ = BREADTH OF CREST ≈ 13FT, AND REF 12, PG 46); AND
H = AVERAGE "FLOW-AREA WEIGHTED" HEAD ABOVE THE LOW TOP OF DAM EL 1501.7 FT. THE CREST PROFILE IS ROUGHLY TRIANGULAR IN SHAPE, WITH THE RIGHT SIDE OF THE TRIANGLE TERMINATING AT ABOUT EL 1502.6 FT

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-31-79 PROJ. NO. 79-617-195

CHKD. BY DJS DATE 9-1-79 SHEET NO. 16 OF 18

gai CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

NEAR THE SPILLWAY, WHILE THE LEFT SIDE OF THE TRIANGULAR EMBANKMENT PROFILE CONTINUES ALONG THE LEFT ABUTMENT TO EL 1506.0 AND ABOVE. THE RIGHT SIDE IS ABOUT 250 FT LONG, AND WILL HAVE A TRIANGULAR FLOW AREA BELOW EL 1502.6, AND A TRAPEZOIDAL FLOW AREA ABOVE. THE LEFT SIDE IS ABOUT 520 FT LONG, AND WILL HAVE A TRIANGULAR FLOW AREA AT ALL ELEVATIONS.

- EMBANKMENT RATING CURVE IS GIVEN ON SHEET 17.

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM
BY WJV DATE 8-31-79 PROJ. NO. 79-617-195
CHKD. BY DJS DATE 9-1-79 SHEET NO. 17 OF 18

- EMBANKMENT RATING TABLE:

RESERVOIR ELEVATION (FT)	LEFT SIDE ① H_1 (FT)	② A_1 (FT²)	$H_1 \times A_1$ (FT³)	RIGHT SIDE ③ H_2 (FT)	④ A_2 (FT²)	$H_2 \times A_2$ (FT³)	⑤ WEIGHTED H (FT)	H/ℓ (FT/FT)	⑥ C	⑦ L (FT)	⑧ EMBANKMENT Q (CFS)
1501.7	0	–	–	0	–	–	0	–	–	0	0
1501.8	0.05	0.6	0.03	0.05	1.4	0.07	0.05	≈0.01	2.90	40	0
1501.9	0.10	16	1.60	0.10	5.6	0.56	0.10	≈0.01	2.93	220	20
1502.0	0.15	63	9.45	0.15	13	1.95	0.15	0.01	2.95	500	90
1502.4	0.35	145	51	0.35	68	24	0.35	0.03	3.00	610	380
1502.6	0.45	198	89	0.45	113	51	0.45	0.03	3.01	690	630
1502.7	0.50	225	113	0.55	138	76	0.52	0.04	3.02	700	790
1503.0	0.65	299	194	0.85	213	181	0.73	0.06	3.03	710	1340
1504.0	1.2	576	691	1.9	475	903	1.52	0.12	3.04	730	4160
1505.0	1.7	850	1445	2.9	725	2103	2.25	0.17	3.06	750	7750
1506.0	2.2	1144	2516	3.9	975	3803	2.98	0.23	3.08	770	12200

① H_1 = (RESERVOIR ELEVATION − 1501.7 FT)/2

② $A_1 = H_1 \times L_1$, WHERE $L_1 = L - L_2$ BELOW EL 1502.6, AND $L_1 = L - 250$ FT ABOVE;

③ H_2 = (RESERVOIR ELEVATION − 1501.7 FT)/2 BELOW EL 1502.6, AND ABOVE EL 1502.6
$\Rightarrow H_2 = [(\text{RESERVOIR ELEVATION} - 1501.7\text{ FT}) + (\text{RESERVOIR ELEVATION} - 1502.6)]/2$;

④ $A_2 = H_2 \times L_2$, WHERE $L_2 \approx [250\text{FT}/(1502.6 - 1501.7)] \times (2 \times H_2)$ BELOW EL 1502.6, AND $L_2 \approx 250$ FT ABOVE EL 1502.6 FT;

⑤ $H = [(H_1 \times A_1) + (H_2 \times A_2)]/(A_1 + A_2)$;

⑥ REF 12, PG 46;

⑦ FROM SHEET 15;

UNI CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 8-31-79 PROJ. NO. 78-617-195

CHKD. BY DJS DATE 9-1-79 SHEET NO. 18 OF 18

gai CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

TOTAL FACILITY RATING CURVE

TOTAL DISCHARGE ≈ SPILLWAY Q + EMBANKMENT Q

RESERVOIR ELEVATION (FT)	① SPILLWAY Q (CFS)	② EMBANKMENT Q (CFS)	TOTAL Q (CFS)
1495.3	0	–	0
1496.0	110	–	110
1497.0	480	–	490
1498.0	1020	–	1020
1499.0	1760	–	1760
1500.0	2650	–	2650
1501.0	3730	–	3730
1501.7	4510	0	4510
1501.8	* 4650	0	4650
1501.9	* 4790	20	4800
1502.0	4920	90	5010
1502.4	* 5450	380	5830
1502.6	* 5710	630	6340
1502.7	* 5840	790	6630
1503.0	6240	1340	7580
1504.0	7660	4160	11820
1505.0	9260	7750	17010
1506.0	10920	12200	23020

① FROM SHEET 14
② FROM SHEET 17

* STRAIGHT-LINE INTERPOLATION

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 9-4-79 PROJ. NO. 78-617-195

CHKD. BY DLB DATE 9-5-79 SHEET NO. A OF E

gai CONSULTANTS, IN
Engineers • Geologists • Planners
Environmental Specialists

SUMMARY INPUT/OUTPUT SHEETS

```
T1 DAM SAFETY INSPECTION - TAILWATER ON SPILLWAY
T2 START CALCULATIONS VIA CRITICAL DEPTH ASSUMPTION AT SECTION 0.3
T3      MEADOW GROUNDS DAM SPILLWAY DISCHARGE CHANNEL
J1 ICHECK  INO     NINV     IDIR     STRT     METRIC   HVINS    U        WSEL     FU       BACKWATER CURVE COMPUTATIONS FOR TAILWATER ON DAM
       0.      2.       0.       0. -1.000000      0.0      0.0       0.  1487.500      0.0
J2 NPROF   IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE
       1.000    0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
J3 VARIABLE CODES FOR SUMMARY PRINTOUT
      36.000   39.000   42.000   43.000    1.000    2.000    3.000   26.000    0.0      0.0
J5 LPRNT   NUMSEC   ********REQUESTED SECTION NUMBERS********
     -10.000  -10.000    0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
NC     0.045    0.045    0.040    0.100    0.300    0.0      0.0      0.0      0.0      0.0
GR    14.000  500.000 1000.000 2000.000 3000.000 4000.000 5000.000 6000.000 7000.000 8000.000
GR  9000.000 10000.000 11000.000 12000.000 13000.000    0.0      0.0      0.0      0.0      0.0
X1     0.300    6.000  131.000  186.000    0.0      0.0      0.0      0.0      0.0      0.0
GR  1502.000    0.0   1489.000  131.000 1486.700  135.000 1486.700  182.000 1489.000  186.000
GR  1491.000  218.000    0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
NC     0.040    0.040    0.040    0.200    0.400    0.0      0.0      0.0      0.0      0.0
X1     0.200    5.000   30.000  133.000  135.000  135.000  135.000    0.0      0.0      0.0
GR  1502.000    0.0   1502.000   30.000 1490.200   54.000 1490.200  101.000 1506.100  133.000
NC     0.040    0.040    0.040    0.100    0.300    0.0      0.0      0.0      0.0      0.0
X1     0.100    0.0      0.0      0.0      0.0     40.000   40.000   40.000    0.0      0.0
EJ     0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
```

SUBJECT DAM SAFETY INSPECTION

MEADOW GROUNDS DAM

BY WJV DATE 9-4-79 PROJ. NO. 78-617-195

CHKD. BY DLB DATE 9-5-79 SHEET NO. B OF E

GEI CONSULTANTS, INC

Engineers • Geologists • Planners
Environmental Specialists

SUMMARY PRINTOUT

	SECNO	XLCH	ELMIN	DISCHARGE Q	ELEVATION CWSEL	CRIWS	EG	VCH
SECTION @ ≈ 175 FT DS FROM SPILLWAY WEIR	0.300	0.0	1486.70	500.00	1488.19	1488.19	1488.90	6.78
	0.300	0.0	1486.70	1000.00	1489.03	1489.03	1490.13	8.40
	0.300	0.0	1486.70	2000.00	1490.46	1490.46	1491.86	9.68
	0.300	0.0	1486.70	3000.00	1491.49	1491.49	1493.04	10.50
	0.300	0.0	1486.70	4000.00	1492.19	1492.19	1493.99	11.50
	0.300	0.0	1486.70	5000.00	1492.84	1492.84	1494.83	12.25
	0.300	0.0	1486.70	6000.00	1493.38	1493.38	1495.59	13.05
	0.300	0.0	1486.70	7000.00	1493.88	1493.88	1496.28	13.73
	0.300	0.0	1486.70	8000.00	1494.38	1494.38	1496.93	14.24
	0.300	0.0	1486.70	9000.00	1494.84	1494.84	1497.54	14.75
	0.300	0.0	1486.70	10000.00	1495.27	1495.27	1498.12	15.23
	0.300	0.0	1486.70	11000.00	1495.68	1495.68	1498.67	15.66
	0.300	0.0	1486.70	12000.00	1496.08	1496.08	1499.19	16.05
	0.300	0.0	1486.70	13000.00	1496.46	1496.46	1499.69	16.45
SECTION @ ≈ 40 FT DS FROM SPILLWAY WEIR	0.200	135.00	1490.20	500.00	1491.68	1491.68	1492.39	6.74
	0.200	135.00	1490.20	1000.00	1492.52	1492.52	1493.60	8.32
	0.200	135.00	1490.20	2000.00	1493.82	1493.82	1495.43	10.16
	0.200	135.00	1490.20	3000.00	1494.87	1494.87	1496.88	11.38
	0.200	135.00	1490.20	4000.00	1495.78	1495.78	1498.13	12.29
	0.200	135.00	1490.20	5000.00	1496.58	1496.58	1499.24	13.08
	0.200	135.00	1490.20	6000.00	1497.32	1497.32	1500.24	13.71
	0.200	135.00	1490.20	7000.00	1498.02	1498.02	1501.17	14.26
	0.200	135.00	1490.20	8000.00	1498.67	1498.67	1502.04	14.74
	0.200	135.00	1490.20	9000.00	1499.28	1499.28	1502.85	15.16
	0.200	135.00	1490.20	10000.00	1499.86	1499.86	1503.62	15.55
	0.200	135.00	1490.20	11000.00	1500.41	1500.41	1504.35	15.92
	0.200	135.00	1490.20	12000.00	1500.95	1500.95	1505.04	16.24
	0.200	135.00	1490.20	13000.00	1501.43	1501.43	1505.71	16.60
SECTION @ TOE OF SPILLWAY WEIR	0.100	40.00	1490.20	500.00	1492.51	0.0	1492.78	4.18
	0.100	40.00	1490.20	1000.00	1493.55	0.0	1494.02	5.55
	0.100	40.00	1490.20	2000.00	1495.06	0.0	1495.88	7.24
	0.100	40.00	1490.20	3000.00	1496.26	0.0	1497.35	8.37
	0.100	40.00	1490.20	4000.00	1497.28	0.0	1498.60	9.21
	0.100	40.00	1490.20	5000.00	1498.20	0.0	1499.72	9.90
	0.100	40.00	1490.20	6000.00	1499.02	0.0	1500.73	10.49
	0.100	40.00	1490.20	7000.00	1499.78	0.0	1501.66	11.02
	0.100	40.00	1490.20	8000.00	1500.48	0.0	1502.53	11.49
	0.100	40.00	1490.20	9000.00	1501.16	0.0	1503.35	11.87
	0.100	40.00	1490.20	10000.00	1501.79	0.0	1504.12	12.25
	0.100	40.00	1490.20	11000.00	1502.41	0.0	1504.85	12.55
	0.100	40.00	1490.20	12000.00	1503.06	0.0	1505.54	12.69
	0.100	40.00	1490.20	13000.00	1503.72	0.0	1506.22	12.75

SUBJECT DAM SAFETY INSPECTION — MEADOW GROUNDS DAM — OVERTOPPING

BY WJV DATE 9-4-79 PROJ. NO. 78-617-195

CHKD. BY DLB DATE 9-5-79 SHEET NO. C OF E

GEI CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

DAM SAFETY INSPECTION
MEADOW GROUNDS DAM ****** OVERTOPPING ANALYSIS ******
15-MINUTE TIME-STEP AND 48-HOUR STORM DURATION

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	15	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 3 LRTIO= 1
RTIOS= .80 .90 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW INTO MEADOW GROUNDS LAKE

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	3.20	0.00	3.20	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	113.00	124.00	132.00	143.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

INITIAL AND CONSTANT RAINFALL LOSSES AS PER COE

LOSS DATA

DLOPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 3.43 CP= .70 NTA= 0

BASE FLOW PARAMETERS AS PER COE

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=15.82 AND R=10.06 INTERVALS

UNIT HYDROGRAPH 62 END-OF-PERIOD ORDINATES, LAG= 3.42 HOURS, CP= .70 VOL= 1.00

9.	33.	67.	106.	148.	193.	239.	286.	331.	368.
397.	417.	429.	432.	426.	408.	376.	340.	308.	279.
252.	228.	207.	187.	170.	153.	139.	126.	114.	103.
93.	85.	77.	69.	63.	57.	51.	47.	42.	38.
35.	31.	28.	26.	23.	21.	19.	17.	16.	14.
13.	12.	10.	9.	9.	8.	7.	6.	6.	5.
5.	4.								

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM
BY WJV DATE 9-4-79 PROJ. NO. 78-617-135
CHKD. BY DLB DATE 9-5-79 SHEET NO. D OF E

GEI CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

O MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	END-OF-PERIOD FLOW MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	27.46	25.04	2.41	208199.
										(697.)	(636.)	(61.)	(5895.54)

RESERVOIR INFLOW HYDROGRAPHS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7147.	5548.	2054.	723.	208200.
CMS	202.	157.	58.	20.	5896.
INCHES		16.13	23.89	25.22	25.22
MM		409.68	606.73	640.54	640.54
AC-FT		2751.	4075.	4302.	4302.
THOUS CU M		3394.	5026.	5306.	5306.

PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	6432.	4994.	1849.	651.	187380.
CMS	182.	141.	52.	18.	5306.
INCHES		14.52	21.50	22.70	22.70
MM		368.71	546.06	576.48	576.48
AC-FT		2476.	3667.	3871.	3871.
THOUS CU M		3054.	4523.	4775.	4775.

0.9 PMF

HYDROGRAPH ROUTING

ROUTE INFLOW THROUGH RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
101	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1495.	-1

STAGE	1495.30	1496.00	1497.00	1498.00	1499.00	1500.00	1501.00	1501.70	1501.80
	1502.00	1502.40	1502.60	1502.70	1503.00	1504.00	1505.00	1506.00	
FLOW	0.00	110.00	480.00	1020.00	1760.00	2650.00	3730.00	4510.00	4650.00
	5010.00	5830.00	6340.00	6630.00	7580.00	11820.00	17010.00	23020.00	
SURFACE AREA=	0.	206.	257.	271.	419.				
CAPACITY=	0.	3131.	4217.	4666.	10930.				
ELEVATION=	1450.	1495.	1500.	1502.	1520.				

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1495.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1501.7	0.0	0.0	0.

SUBJECT DAM SAFETY INSPECTION
MEADOW GROUNDS DAM

BY WJV DATE 9-4-79 PROJ. NO. 78-617-185

CHKD. BY DLB DATE 9-5-79 SHEET NO. E OF E

gai CONSULTANTS, IN
Engineers • Geologists • Planners
Environmental Specialists

PMF

0.9PMF

RESERVOIR OUTFLOW HYDROGRAPHS

PEAK OUTFLOW IS 5091. AT TIME 44.75 HOURS

		PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
	CFS	5091.	4294.	1949.	701.	201987.
	CMS	144.	122.	55.	20.	5720.
	INCHES		12.48	22.67	24.47	24.47
	MM		317.05	575.70	621.42	621.42
	AC-FT		2129.	3866.	4173.	4173.
	THOUS CU M		2626.	4769.	5148.	5148.

PEAK OUTFLOW IS 4391. AT TIME 45.00 HOURS

OVERTOPPING OCCURS @ ≈ 0.92 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4391.	3806.	1747.	630.	181305.
CMS	124.	108.	49.	18.	5134.
INCHES		11.06	20.32	21.96	21.96
MM		281.02	516.01	557.79	557.79
AC-FT		1887.	3469.	3746.	3746.
THOUS CU M		2328.	4274.	4621.	4621.

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1495.30	1495.30	1501.70
STORAGE	3131.	3131.	4666.
OUTFLOW	0.	0.	4510.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.80	1501.10	0.00	4505.	3844.	0.00	45.00	0.00
.90	1501.59	0.00	4637.	4391.	0.00	45.00	0.00
1.00	1502.04	.34	4758.	5091.	2.50	44.75	0.00

LIST OF REFERENCES

1. "Recommended Guidelines for Safety Inspection of Dams," prepared by Department of the Army Office of the Chief of Engineers, Washington, D. C. (Appendix D).

2. "Unit Hydrograph Concepts and Calculations," by Corps of Engineers, Baltimore District (L-519).

3. "Seasonal Variation of Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Duration of 6, 12, 24, and 48 Hours," Hydrometeorological Report No. 33, prepared by J. T. Riedel, J. F. Appleby and R. W. Schloemer Hydrologic Service Division Hydrometeorological Section, U. S. Department of the Army, Corps of Engineers, Washington, D. C., April 1956.

4. Design of Small Dams, U. S. Department of the Interior, Bureau of Reclamation, Washington, D. C., 1973.

5. Handbook of Hydraulics, H. W. King and E. F. Brater, McGraw-Hill, Inc., New York, 1963.

6. Standard Handbook for Civil Engineers, F. S. Merritt McGraw-Hill, Inc., New York, 1968.

7. Open-Channel Hydraulics, V. T. Chow, McGraw-Hill, Inc., New York, 1959.

8. Weir Experiments, Coefficients, and Formulas, R. E. Horton, Water Supply and Irrigation Paper No. 200, Department of the Interior, United States Geological Survey, Washington, D. C., 1907.

9. "Probable Maximum Precipitation Susquehanna River Drainage Above Harrisburg, Pennsylvania," Hydrometeorological Report 40, prepared by H. V. Goodyear and J. T. Riedel, Hydrometeorological Branch Office of Hydrology, U. S. Weather Bureau, U. S. Department of Commerce, Washington, D. C., May 1965.

10. Flood Hydrograph Package (HEC-1) Dam Safety Version, Hydrologic Engineering Center, U. S. Army Corps of Engineers, Davis, California, July 1978.

11. "Simulation of Flow Through Broad Crest Navigation Dams with Radial Gates," R. W. Schmitt, U. S. Army Corps of Engineers, Pittsburgh District.

12. "Hydraulics of Bridge Waterways," BPR, 1970, Discharge Coefficient Based on Criteria for Embankment Shaped Weirs, Figure 24, page 46.

13. Applied Hydraulics in Engineering, Morris, Henry M. and Wiggert, James N., Virginia Polytechnic Institute and State University, 2nd Edition, The Ronald Press Company, New York, 1972.

14. Standard Mathematical Tables, 21st Edition, The Chemical Rubber Company, 1973, page 15.

15. Engineering Field Manual, U. S. Department of Agriculture, Soil Conservation Service, 2nd Edition, Washington, D. C. 1969.

APPENDIX D

PHOTOGRAPHS

PHOTOGRAPH 1 View of reservoir and watershed.

PHOTOGRAPH 2 Overview of embankment from right abutment.

PHOTOGRAPH 3 View of left abutment-embankment contact and downstream slope.

PHOTOGRAPH 4 View of seepage emanating along left abutment-embankment contact.

1

2

3

4

PHOTOGRAPH 5 View showing upstream slope (left of center) and spillway (extreme right).

PHOTOGRAPH 6 View of spillway from right sidewall.

PHOTOGRAPH 7 View of spillway from downstream, left channel wall.

PHOTOGRAPH 8 Downstream view of spillway channel from weir crest.

5

6

7

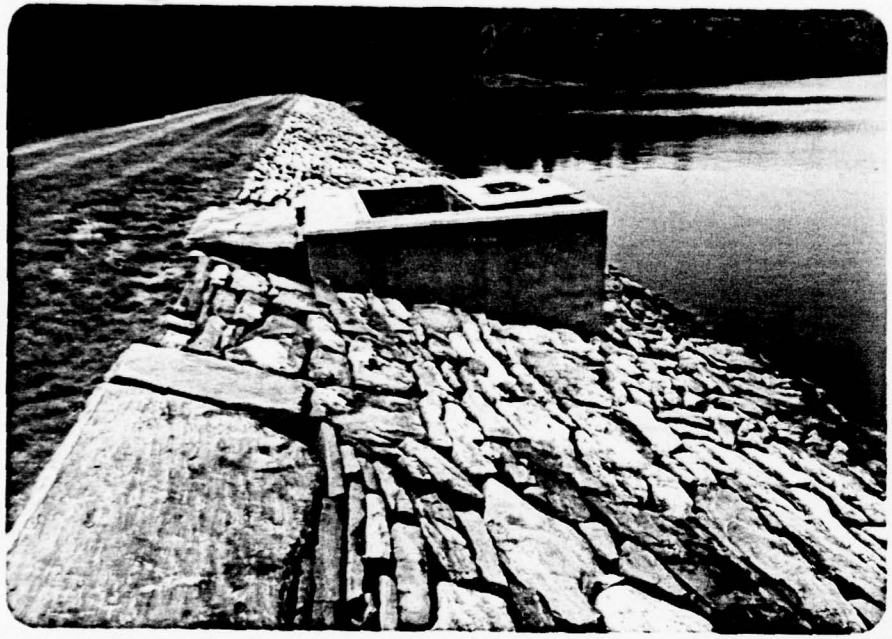
8

PHOTOGRAPH 9 View showing top of control riser and hand-placed riprap.

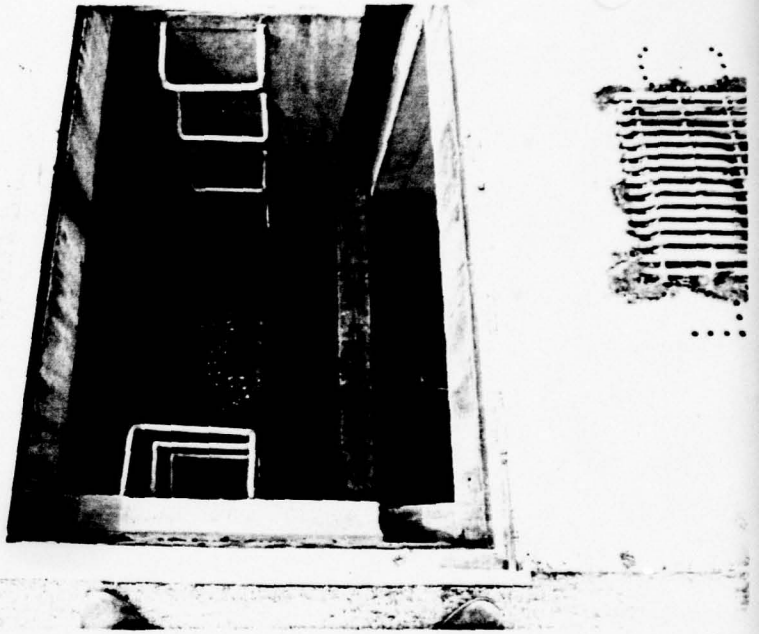
PHOTOGRAPH 10 View of interior of control riser.

PHOTOGRAPH 11 View of outlet endwall and stagnant pool.

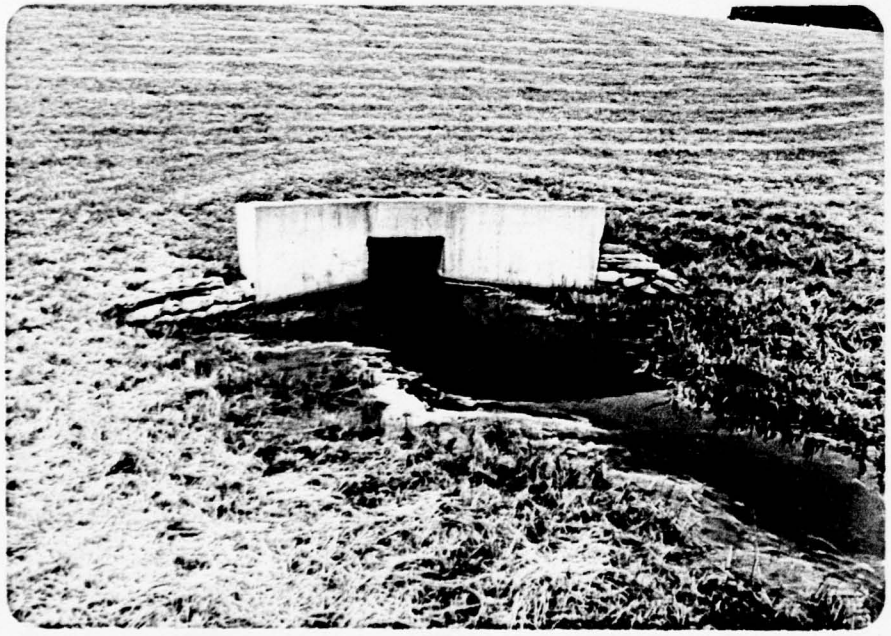
PHOTOGRAPH 12 View of outlet discharge channel taken from embankment crest.



9



10



11

12

APPENDIX E

GEOLOGY

Geology

Meadow Grounds Dam is located in the Appalachian Mountain Section of the Valley and Ridge Province of central Pennsylvania. This section lies immediately east of the Allegheny Front and is a region in sharp contrast with the plateaus country west of the Front. The Appalachian Mountain Section is composed of a broad band of long, narrow mountain ridges and intermontane valleys which cross the state from the south-central border nearly to the northeast corner. Intense lateral compression from the southeast produced a series of high amplitude anticlines and synclines whose axes generally trend in a southwest-northeast direction. Folding was followed by uplift and, subsequent erosion cut valleys in the soft nonresistant beds and left the hard, resistant strata as ridges.

Although no faulting occurs in the immediate vicinity of the dam, the area east of the site including the eastern edge of Blair County and much of Franklin County has more large, mapped faults than in any other equivalent area in the Valley and Ridge Province of Pennsylvania, Maryland, West Virginia, and northern Virginia. Approximately 2 miles east of the site is the southwest-northeast trending Little Scrub Ridge fault zone. This major fault zone is primarily a high-angle thrust fault exhibiting approximately 5,000 feet of dip-slip movement along a strike length of 25 miles. A maximum displacement of 3 miles along this fault zone

occurs several miles northeast of the site.[2]

The dam and reservoir are located on Roaring Run in a high synclinal valley on Meadow Grounds Mountain. The valley containing the reservoir is a structural basin formed by the Timber Ridge Syncline, striking N15°E.

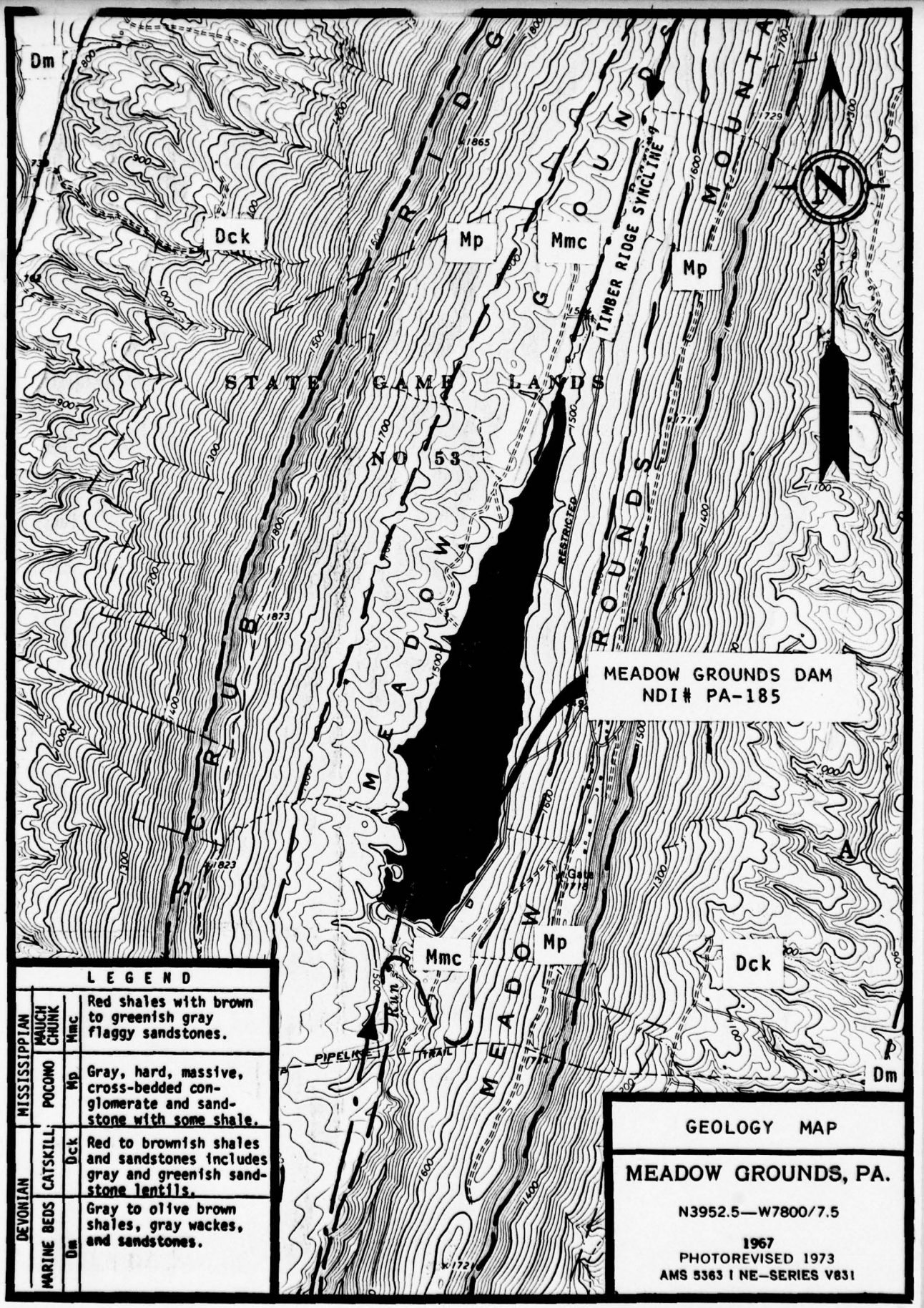
Roaring Run, which roughly follows the axis of the Timber Ridge Syncline, joins Cove Creek approximately 3.5 miles downstream of the dam. Cove Creek is one of the northernmost streams draining the Potomac watershed.

The dam is founded on alluvial silty clay and sand overlying the soft red shale of the Mauch Chunk formation of Mississippian age.

---

[1] Lohman, Stanley W., "Ground Water in South Central Pennsylvania," Pennsylvania Geologic Survey, Report No. W5, Harrisburg, 1938.

[2] Pierce, Kenneth L., "Bedrock and Surficial Geology of the McConnellsburg Quadrangle, Pennsylvania," Topographic and Geologic Survey, Atlas 1090, Harrisburg, 1966.



LEGEND			
DEVONIAN	MISSISSIPPIAN	MAUCH CHUNK	Mmc	Red shales with brown to greenish gray flaggy sandstones.
		POCONO	Mp	Gray, hard, massive, cross-bedded conglomerate and sandstone with some shale.
		CATSKILL	Dck	Red to brownish shales and sandstones includes gray and greenish sandstone lentils.
		MARINE BEDS	Dm	Gray to olive brown shales, gray wackes, and sandstones.

GEOLOGY MAP

MEADOW GROUNDS, PA.

N3952.5—W7800/7.5

1967
PHOTOREVISED 1973
AMS 5363 I NE—SERIES V831

APPENDIX F

FIGURES

LIST OF FIGURES

Figure	Description/Title
1	General Plan - Field Inspection Notes
2	Topography Plan
3	General Plan and Profiles
4	Core Boring Results and Location
5	Cross-Sections - Spillway Channel
6	Embankment Cross-Sections
7	Control Tower and Conduit
8	Details - Spillway Structure

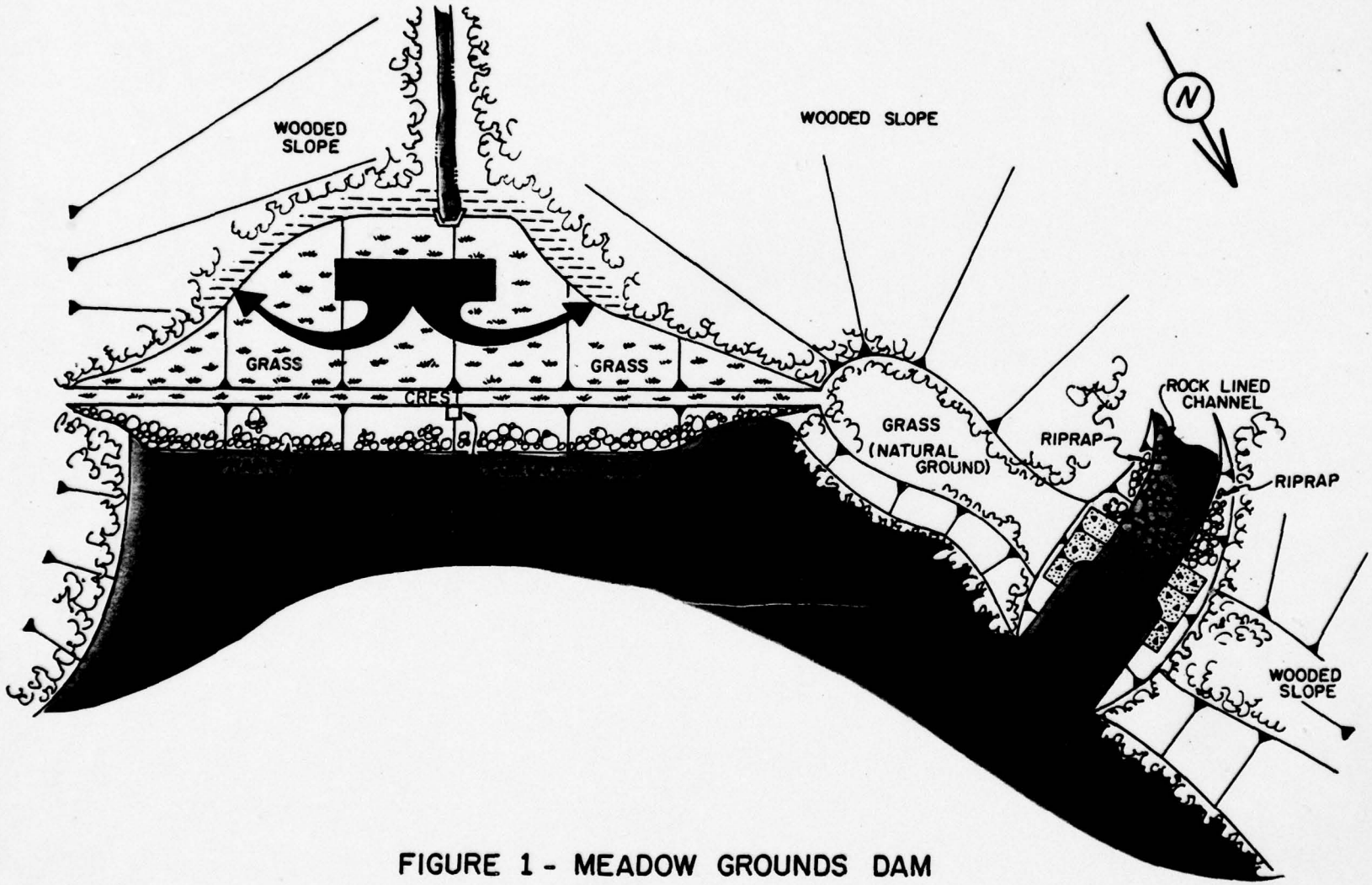
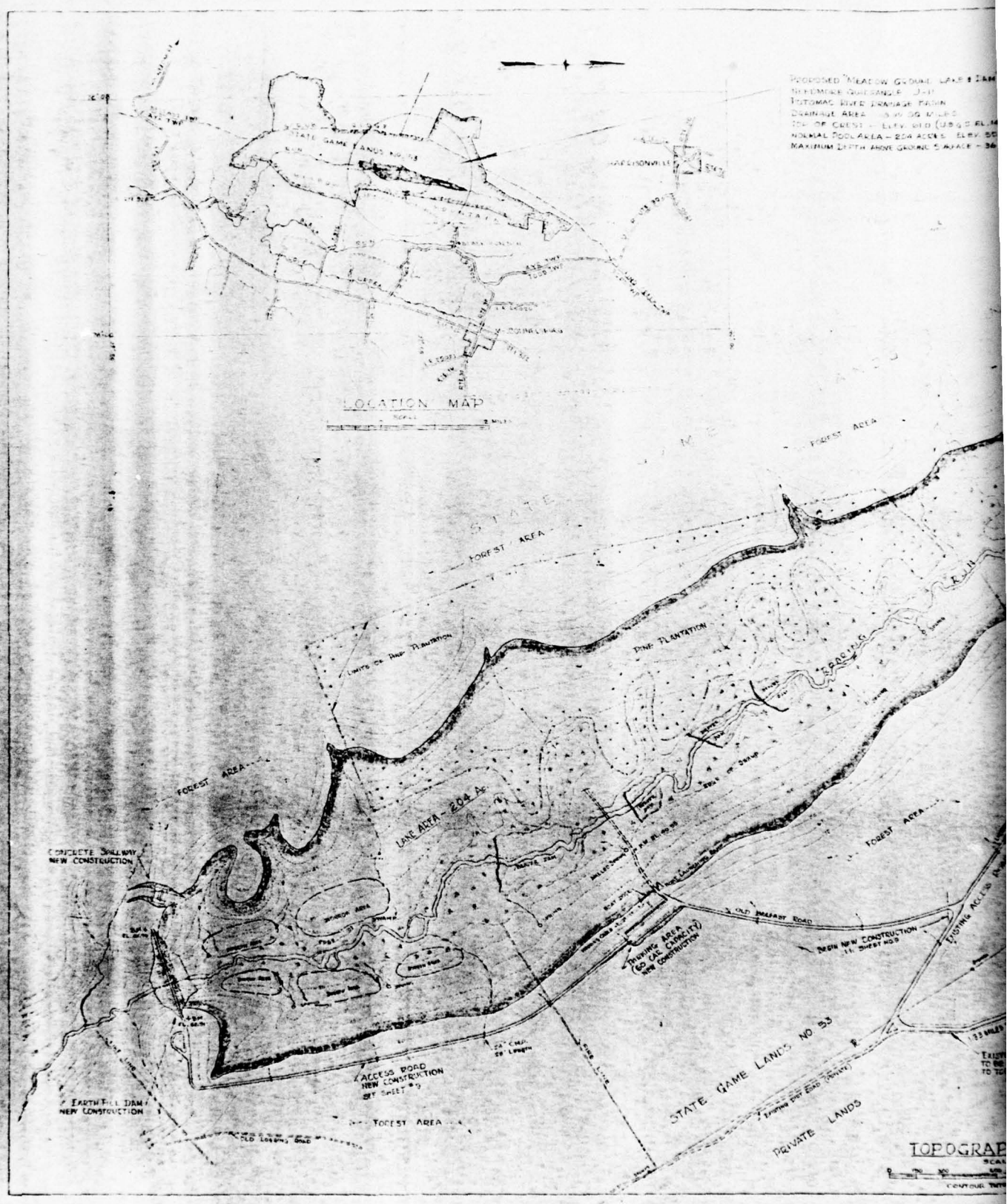


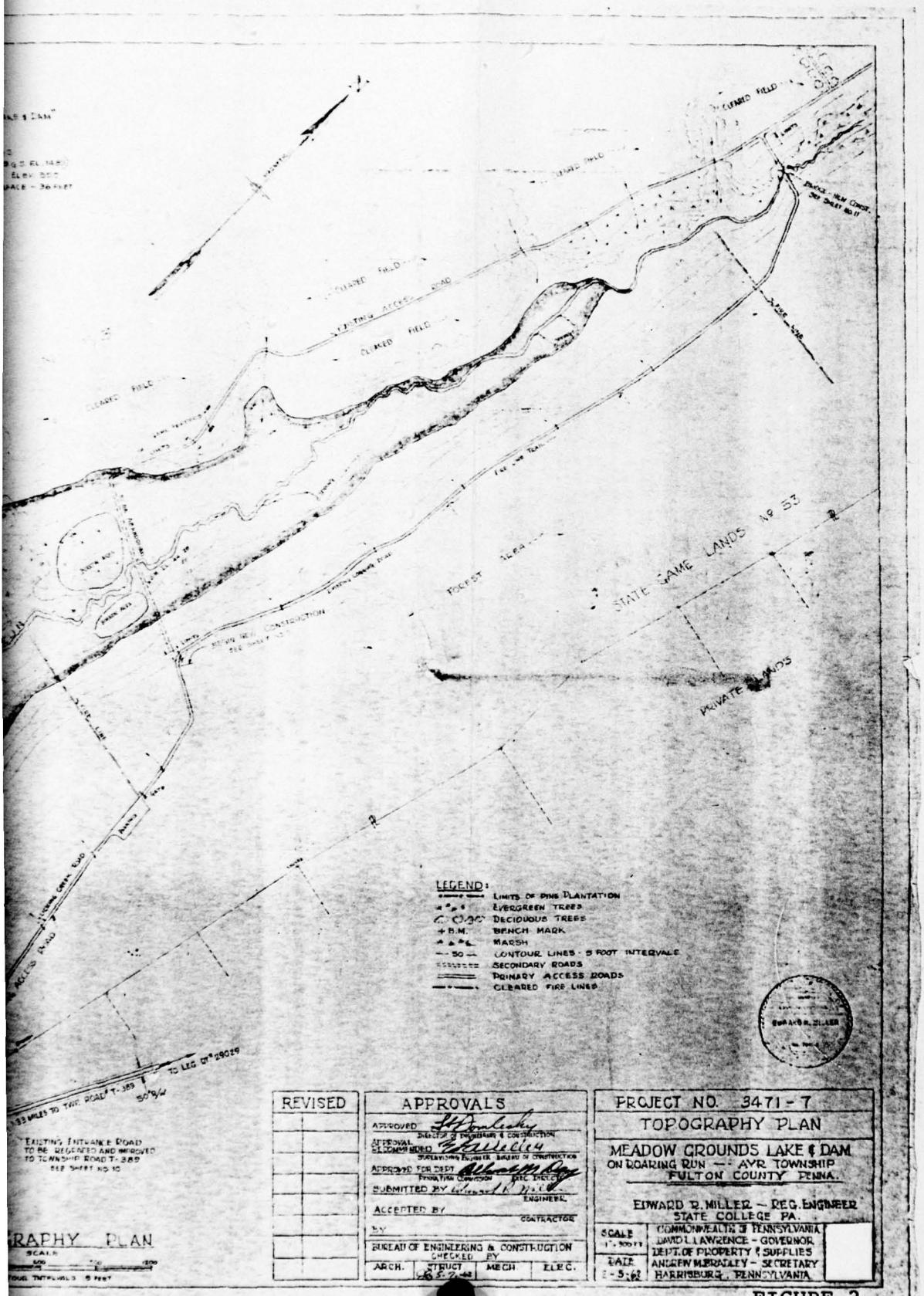
FIGURE 1 - MEADOW GROUNDS DAM

GENERAL PLAN

FIELD INSPECTION NOTES


PROPOSED "MEADOW GROUND LAKE & DAM
NEEDMORE QUADRANGLE
POTOMAC RIVER DRAINAGE BASIN
DRAINAGE AREA
TOP OF CREST - ELEV. 610 (U.S.G.S. EL.
NORMAL POOL AREA - 204 ACRES ELEV. 55
MAXIMUM DEPTH ABOVE GROUND SURFACE - 36
STATE GAME LANDS NO. 53
HARRISONVILLE
LOCATION MAP
SCALE
FOREST AREA
STATE
FOREST AREA
LIMITS OF PINE PLANTATION
PINE PLANTATION
FOREST AREA
LAKE AREA - 204 Ac.
CONCRETE SPILLWAY
NEW CONSTRUCTION
FOREST AREA
OLD BALFAST ROAD
BEGIN NEW CONSTRUCTION
EXISTING ACCESS
THROWING AREA
(60 CAR CAPACITY)
NEW CONSTRUCTION
ACCESS ROAD
NEW CONSTRUCTION
SEE SHEET #9
EARTH FILL DAM
NEW CONSTRUCTION
FOREST AREA
OLD LOGGING ROAD
STATE GAME LANDS NO. 53
PRIVATE LANDS
TOPOGRAP
CONTOUR INT

11



REVISED

APPROVALS

APPROVED _____ DIRECTOR OF ENGINEERING & CONSTRUCTION

APPROVAL RECOMMENDED _____ SUPERVISING ENGINEER, BUREAU OF CONSTRUCTION

APPROVED FOR DEPT _____ DIST. ENGINEER

SUBMITTED BY _____ ENGINEER

ACCEPTED BY _____ CONTRACTOR

BY _____

BUREAU OF ENGINEERING & CONSTRUCTION CHECKED BY

ARCH.	STRUCT	MECH	ELEC.
	5-2-68		

PROJECT NO. 3471-7

TOPOGRAPHY PLAN

MEADOW GROUNDS LAKE & DAM
ON ROARING RUN — AYR TOWNSHIP
FULTON COUNTY PENNA.

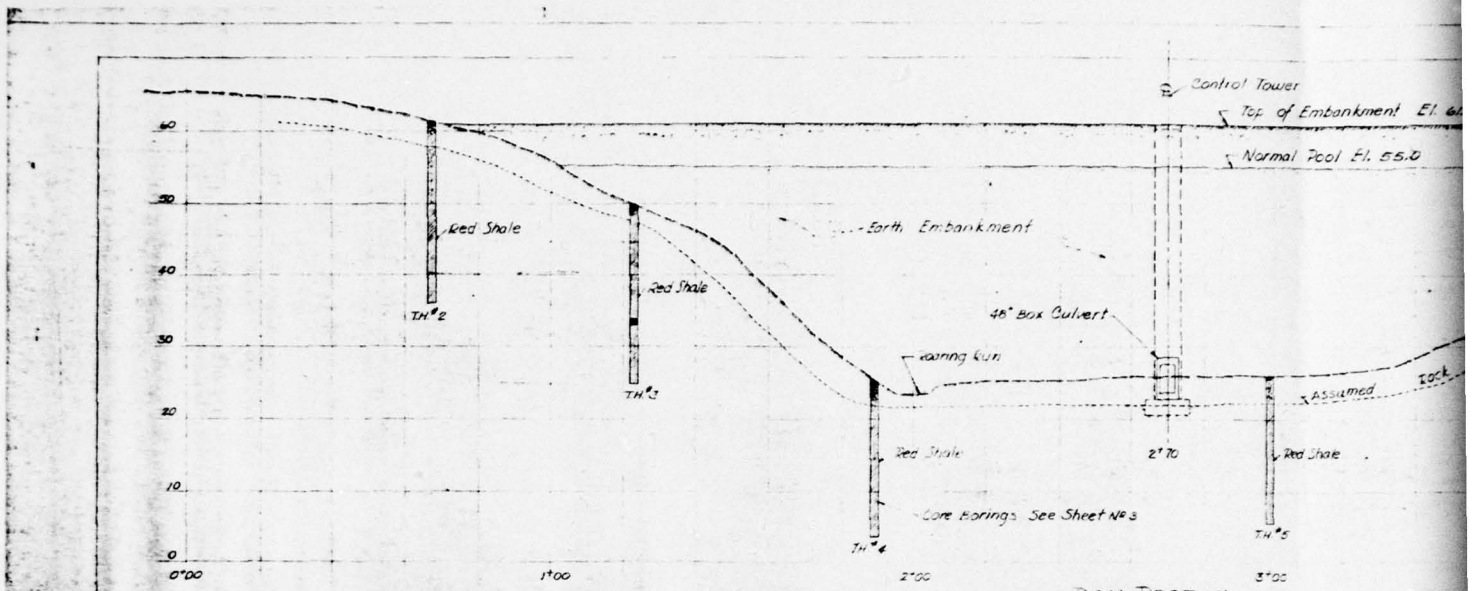
EDWARD R. MILLER — REG. ENGINEER
STATE COLLEGE PA.

SCALE 1" = 200 FT

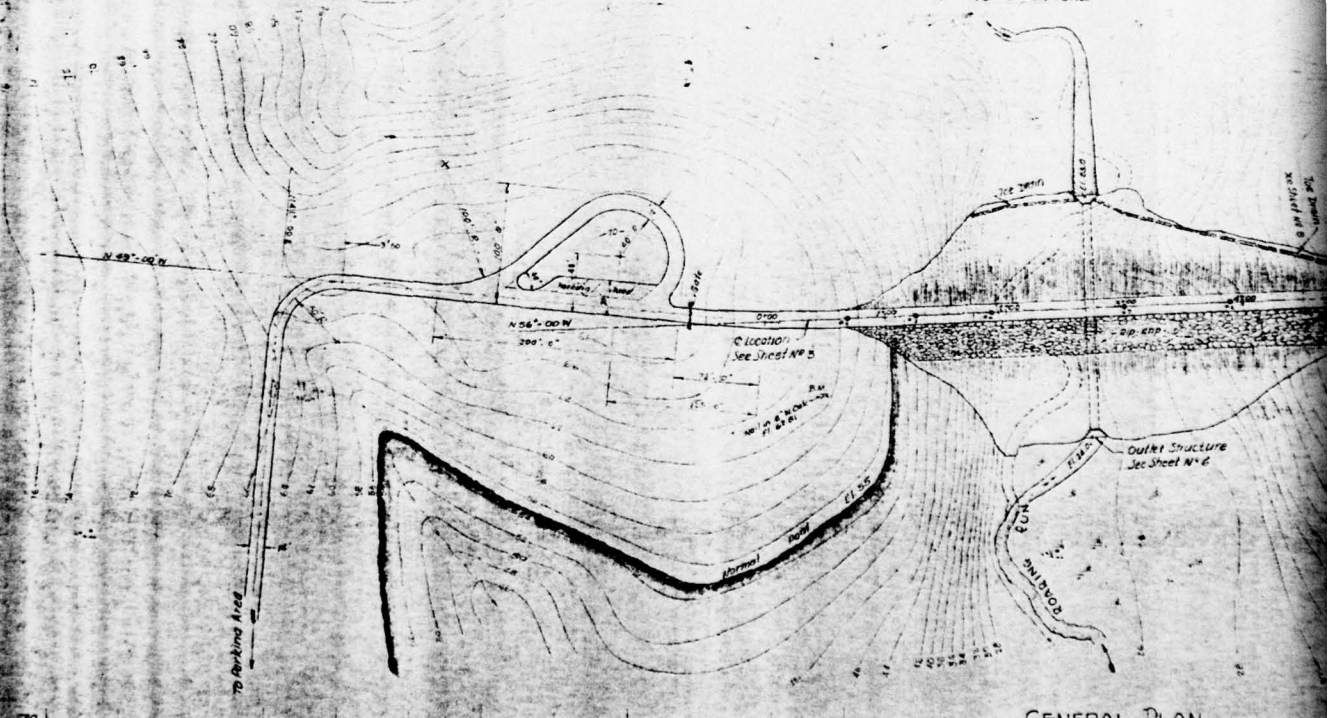
DATE 3-5-68

COMMONWEALTH OF PENNSYLVANIA
DAVID L. LAWRENCE - GOVERNOR
DEPT. OF PROPERTY & SUPPLIES
ANDREW McBRIDE - SECRETARY
HARRISBURG, PENNSYLVANIA

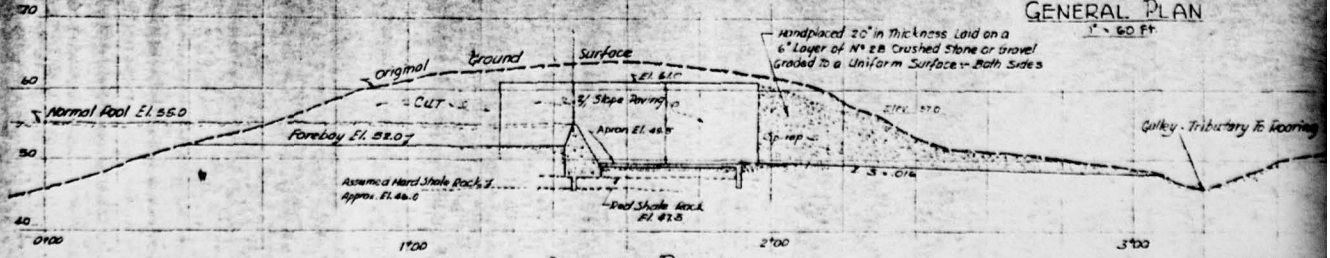
FIGURE 2



DAM PROFILE
1" = 20 Ft. HORIZONTAL
1" = 10 Ft. VERTICAL

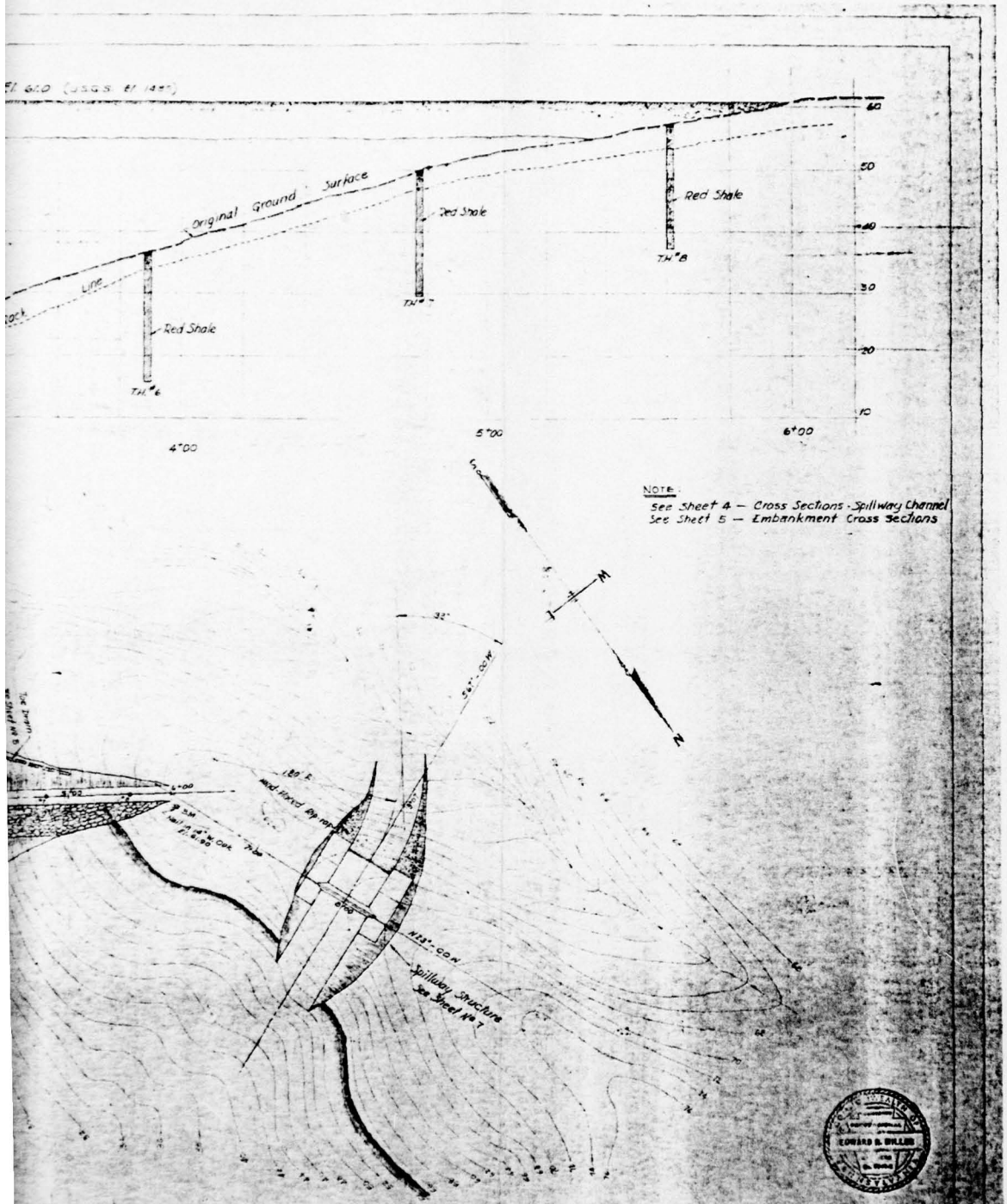


GENERAL PLAN
1" = 60 Ft



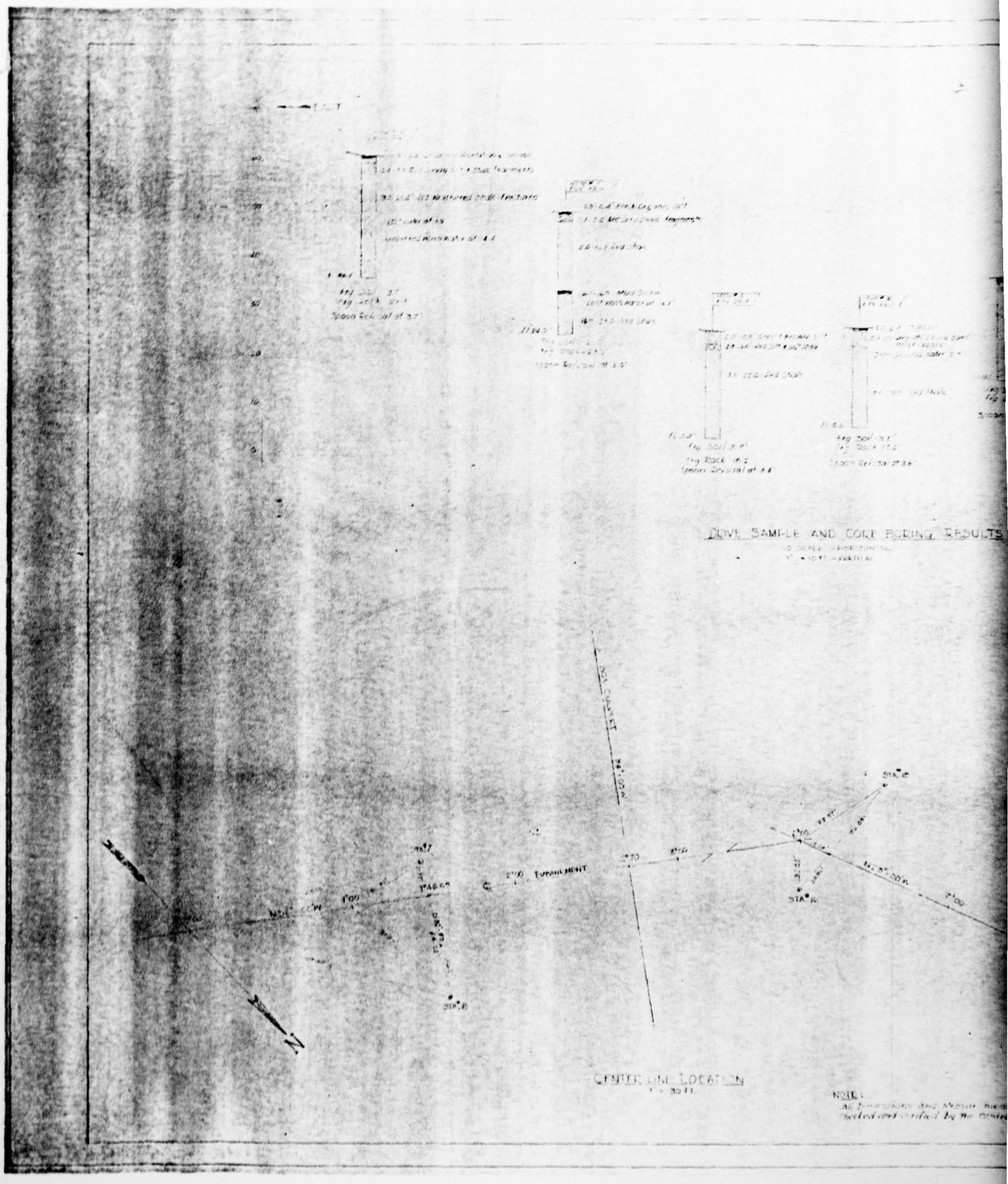
SPILLWAY PROFILE
1" = 20 Ft. HORIZONTAL
1" = 10 Ft. VERTICAL

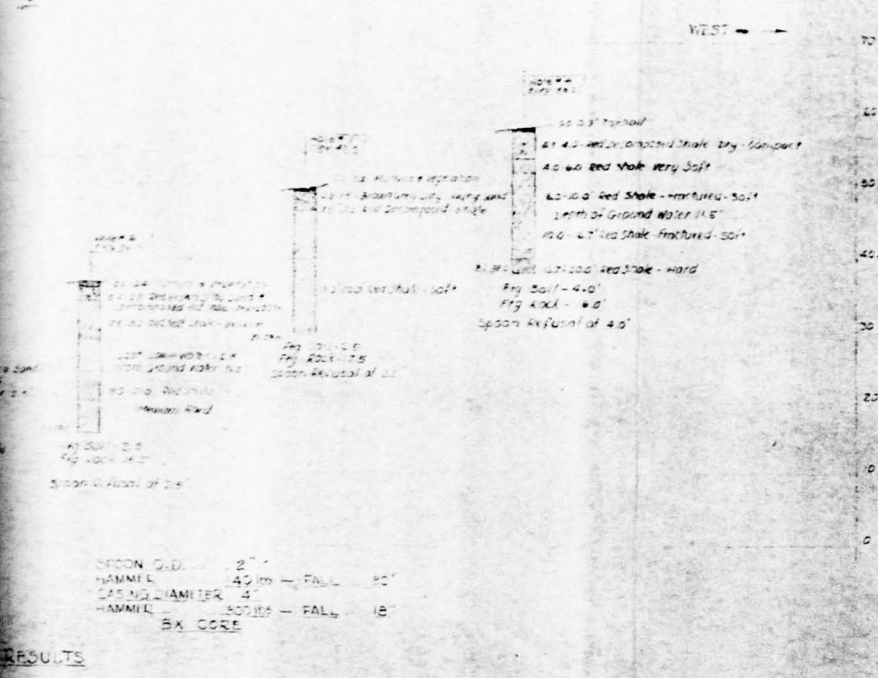
NOTE:
All Dimen
Checked and

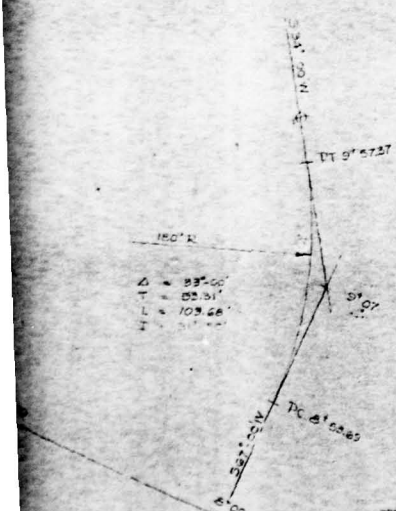


REVISED	APPROVALS	PROJECT NO. 3471-7
	APPROVED ... DIRECTOR OF ENGINEERING & CONSTRUCTION	GENERAL PLAN & PROFILES
	APPROVALS RECOMMENDED ... SUPERVISING ENGINEER ASSIGNED TO CONSTRUCTION	MEADOW GROUNDS LAKE & DAM ON ROARING RUN — AVR TOWNSHIP FULTON COUNTY PENNA.
	APPROVED FOR DEPT. ... PENNA. FISH COMMISSION ... FISH DIRECTOR	EDWARD R. MILLER — REG. ENGINEER STATE COLLEGE, PA.
	SUBMITTED BY ... ENGINEER	SCALE NOTED
	ACCEPTED BY ... CONTRACTOR	DATE 8-30-61
	BY	COMMONWEALTH OF PENNSYLVANIA DAVID L. LAWRENCE — GOVERNOR DEPT. OF PROPERTY & SUPPLIES ANDREW M. BRADLEY — SECRETARY HARRISBURG, PENNSYLVANIA
	BUREAU OF ENGINEERING & CONSTRUCTION CHECKED BY	
	ARCH. ... STRUCT. ... MECH. ... ELEC.	

FIGURE 3


DRIVE SAMPLE AND CORE BORING RESULTS
CENTER LINE LOCATION
1" = 30 FT.
NOTE:





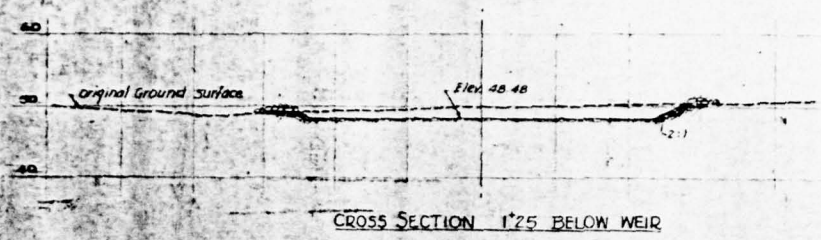
CONCRETE and REINFORCING STEEL SPECIFICATIONS:

1 - Keyways shall be Provided at all Construction Joints and Unless Otherwise Noted Shall be a Minimum of 2½" Deep and 1/3 Section Width.
2 - Deformed Bars and Spacings Noted Thus: — #6 @ 12"
3 - Steel Wire Mesh Noted thus: — 6 x 6 — 2/2
4 - Dowel Bars Shall be The Same Size as Corresponding Wall Bars Unless Otherwise Noted.
5 - Stress Steel is always Shown Vert to the Surface of the Walls or Slabs, and Shall Have The Following Cover From Center of Stress Bar to the Surface.
   1" Where Footer or Slabs are Poured Directly on Ground.
   2" Where after Removal of Forms The Concrete Will be Exposed to the weather or in Contact With the Ground For Bars More than 5/8" in Diameter and
   1½" For Bars Less Than 5/8" in Diameter.
6 - The Amount of Steel Shown Shall be Doubled Through The Construction Joints and For a Distance Not Less Than 24 bar Diameters for a Lapped Splice.
7 - Joints Not indicated on the Drawings Shall be so Made and Located as to Least impair The Strength of the Structure.
8 - All Bars Where Spliced Shall be Lapped 24 x Diameter of Bars.
9 - All Reinforcing Steel Shall be Bent as Noted in Accordance With A.C.I. Building Code Requirements - A.C.I. 318-56.
10 - All Reinforcing Bars Shall Conform To Standard Specification of "The American Society for Testing Materials" - A15-54T; A16-54T; and A305-53T.
11 - All Reinforcing Wire Fabric Shall Conform To the Requirements of A.S.T.M. Designation A185-56T
12 - Ready-mixed Concrete Shall be mixed and Delivered in Accordance With the Requirements Set Forth in "Specifications for Ready-Mixed Concrete" A.S.T.M. - C94 and Shall Conform To The "American Concrete Institute" Standards A.C.I. 318-56
13 - All Expansion or Construction Joints Where Concrete Joins Concrete, Surfaces Shall be Painted With Asphalt Paint.

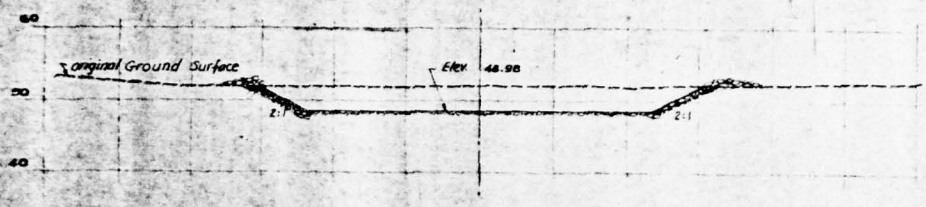
REVISED	APPROVALS	PROJECT NO. 3471-7
	APPROVED [signature]	CORE BORING RESULTS & Φ LOCATION
	APPROVALS RECOMMENDED [signature]	MEADOW GROUNDS LAKE & DAM ON ROARING RUN AYR TOWNSHIP FULTON COUNTY PENNA.
	APPROVED FOR DEPT. [signature]	EDWARD R. MILLER — REG. ENGINEER STATE COLLEGE PA.
	SUBMITTED BY [signature] ENGINEER	
	ACCEPTED BY CONTRACTOR	
	BY	
	BUREAU OF ENGINEERING & CONSTRUCTION CHECKED BY	SCALE NOTED — COMMONWEALTH OF PENNSYLVANIA DAVID L. LAWRENCE - GOVERNOR DEPT. OF PROPERTY & SUPPLIES ANDREW M. BRADLEY - SECRETARY HARRISBURG, PENNSYLVANIA
	ARCH. — STRUCT. 5-7-62 — MECH. — F.L.P.C.	DATE 2-13-62

FIGURE 4

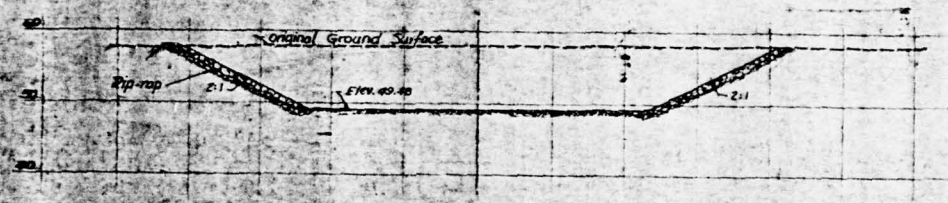
2



CROSS SECTION 1+25 BELOW WEIR

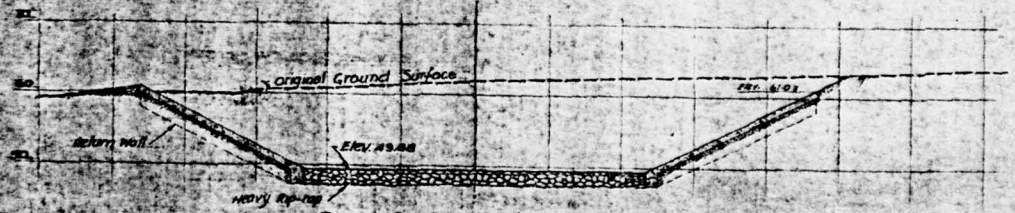


CROSS SECTION 1+00 BELOW WEIR

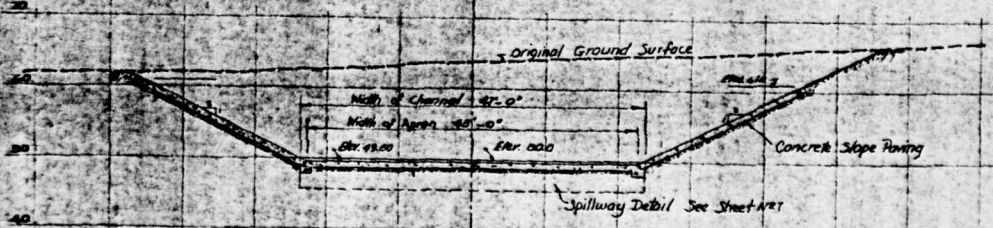


CROSS SECTION 0+75 BELOW WEIR

℄ SPILLWAY



CROSS SECTION 0+50 BELOW WEIR

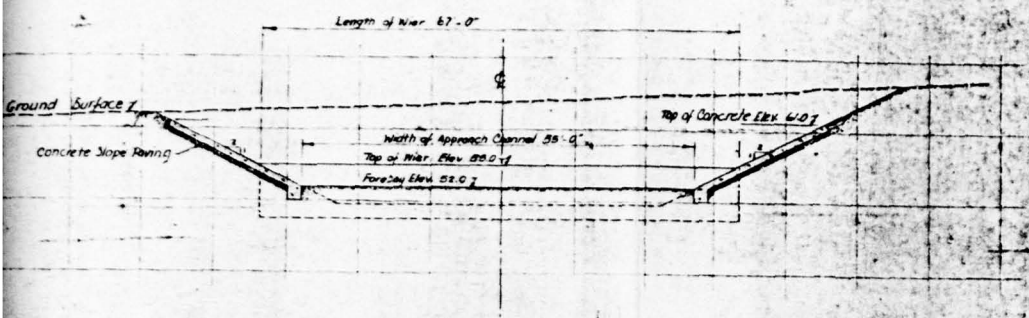


CROSS SECTION 0+25 BELOW WEIR

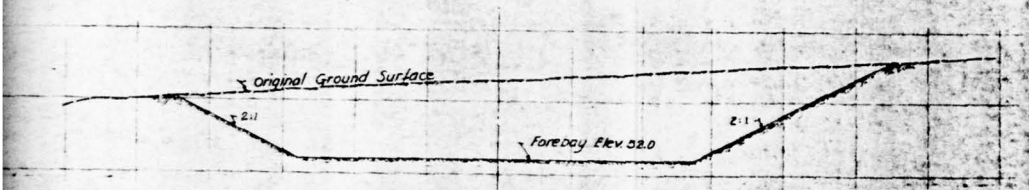
NOTE :-
All Dimension
Checked and
at the Site.

CROSS SECTIONS OF SPILLWAY

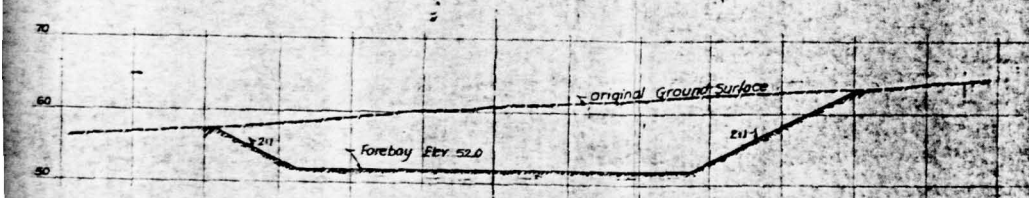
1" = 10 FT. HORIZONTAL
1" = 10 FT. VERTICAL



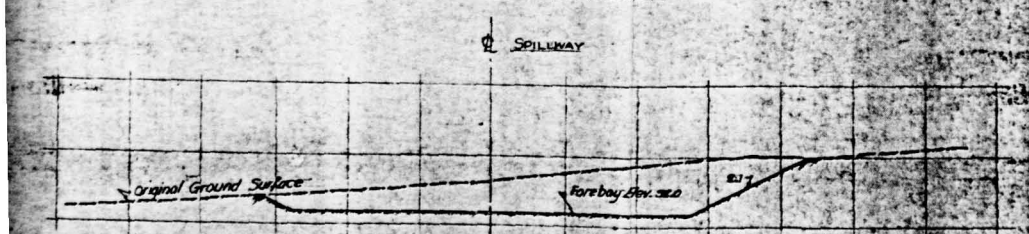
CROSS SECTION AT WEIR



CROSS SECTION 0+25 ABOVE WIER



CROSS SECTION 0+50 ABOVE WEIR



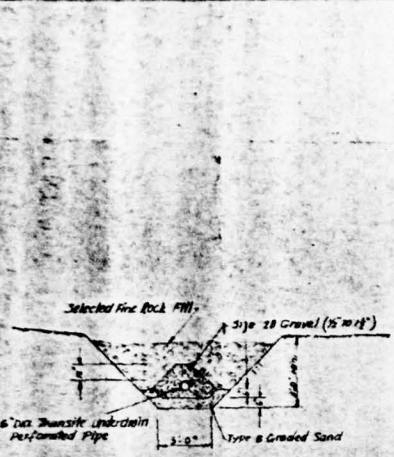
CROSS SECTION 0+75 ABOVE WEIR

...:-
...imensions and Measurements shall be ...ed and verified by the Contractor ...e Site.

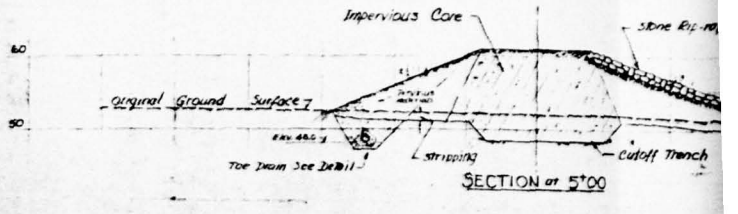
...LWAY

REVISED	APPROVALS	PROJECT NO. 3471-7
	APPROVED [signature] DIRECTOR OF ENGINEERING & CONSTRUCTION	CROSS SECTIONS - SPILLWAY CHANNEL
	APPROVAL RECOMMENDED [signature] SUPERVISING ENGINEER - DIVISION OF CONSTRUCTION	MEADOW GROUNDS LAKE & DAM ON ROARING RUN - AVR TOWNSHIP FULTON COUNTY PENNA.
	APPROVED FOR DEPT. [signature] PENNA. FISH COMMISSION	EDWARD R. MILLER - REG. ENGINEER STATE COLLEGE, PA.
	SUBMITTED BY [signature] ENGINEER	SCALE Noted
	ACCEPTED BY CONTRACTOR	DATE 8-18-61
	BY	COMMONWEALTH OF PENNSYLVANIA DAVID L. LAWRENCE - GOVERNOR DEPT. OF PROPERTY & SUPPLIES ANDREW M. BRADLEY - SECRETARY HARRISBURG PENNSYLVANIA
	BUREAU OF ENGINEERING & CONSTRUCTION CHECKED BY	
	ARCH. STRUCT. [signature] 6-7-62 MECH. ELEC.	FIGURE

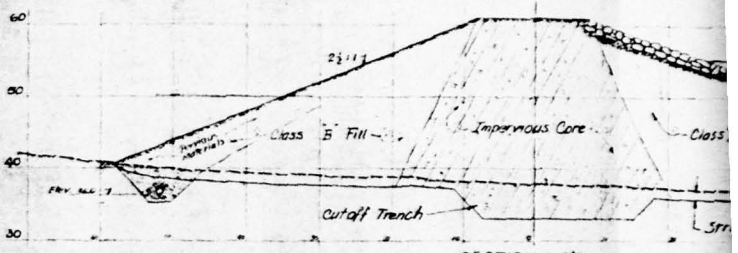
2



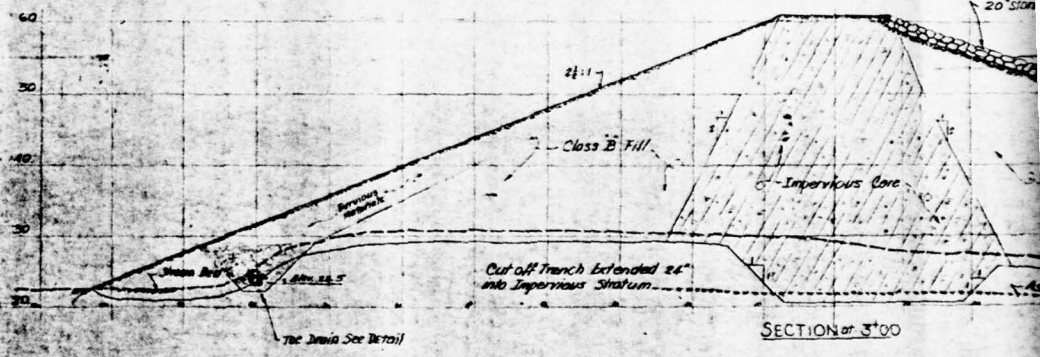
TOE DRAIN DETAIL



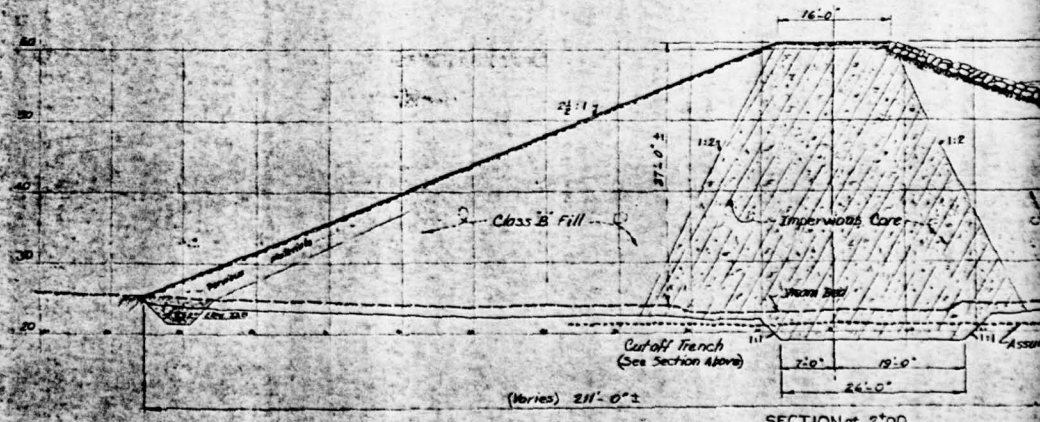
SECTION at 5+00



SECTION at 4+00



SECTION at 3+00

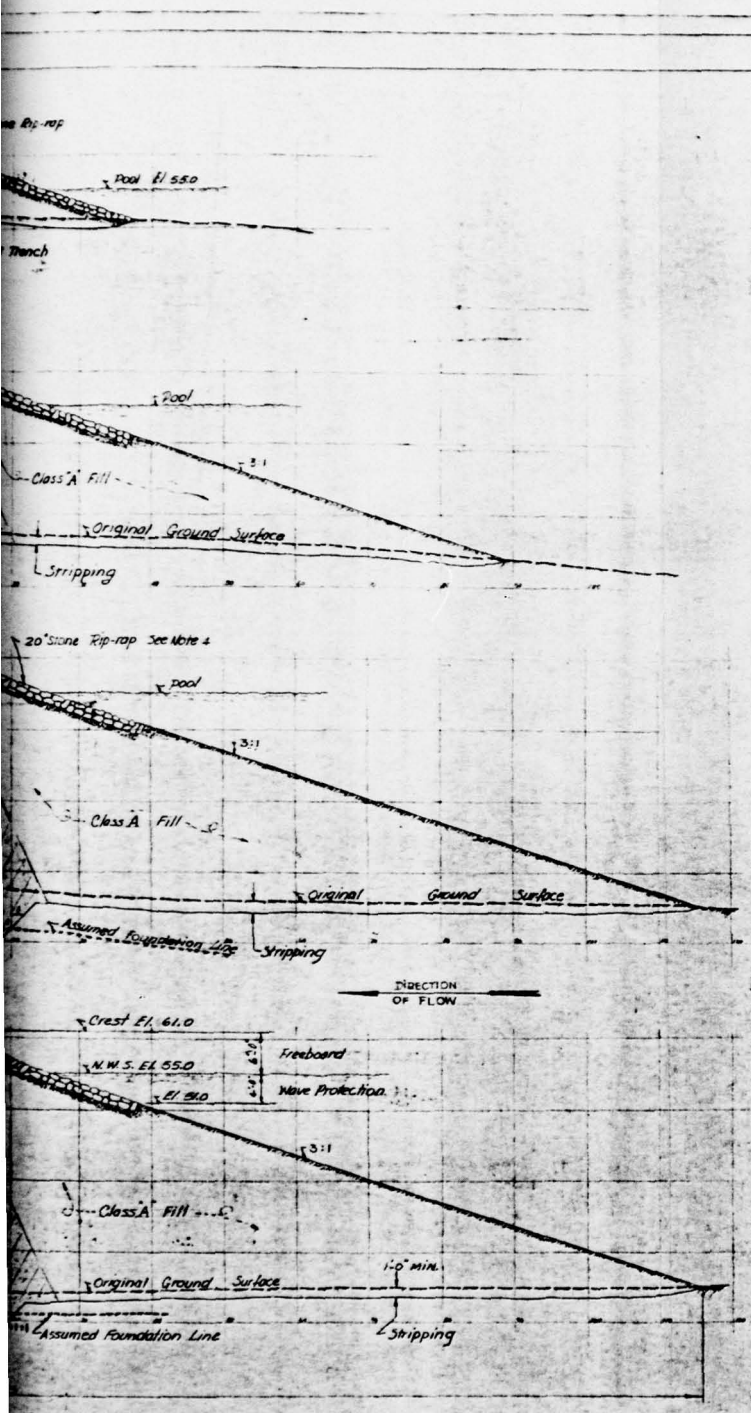


SECTION at 2+00

SECTION at 1+00

CROSS SECTIONS OF EMBANKMENT

1" = 10 FT. HORIZONTAL
1" = 10 FT. VERTICAL

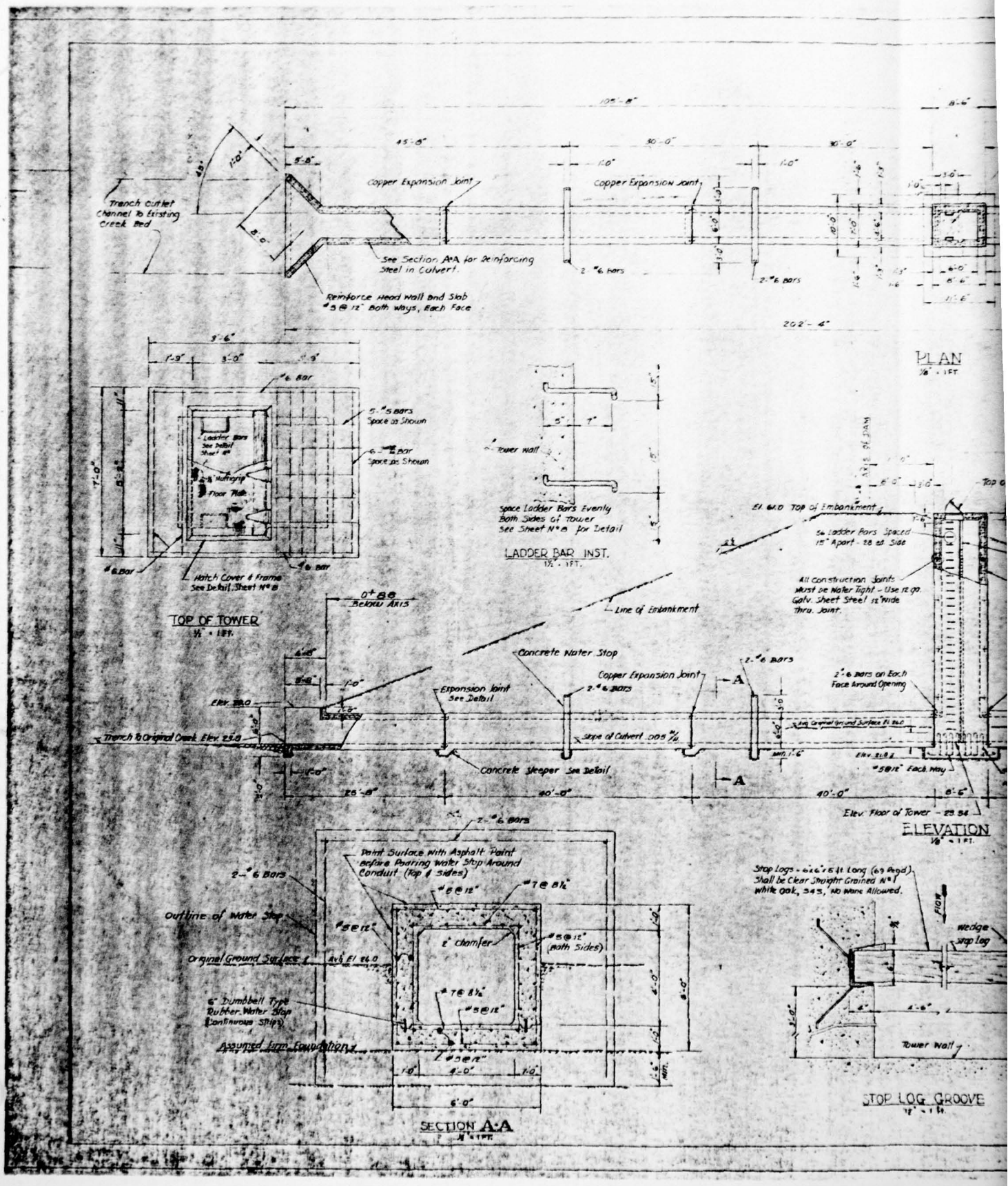


NOTES:

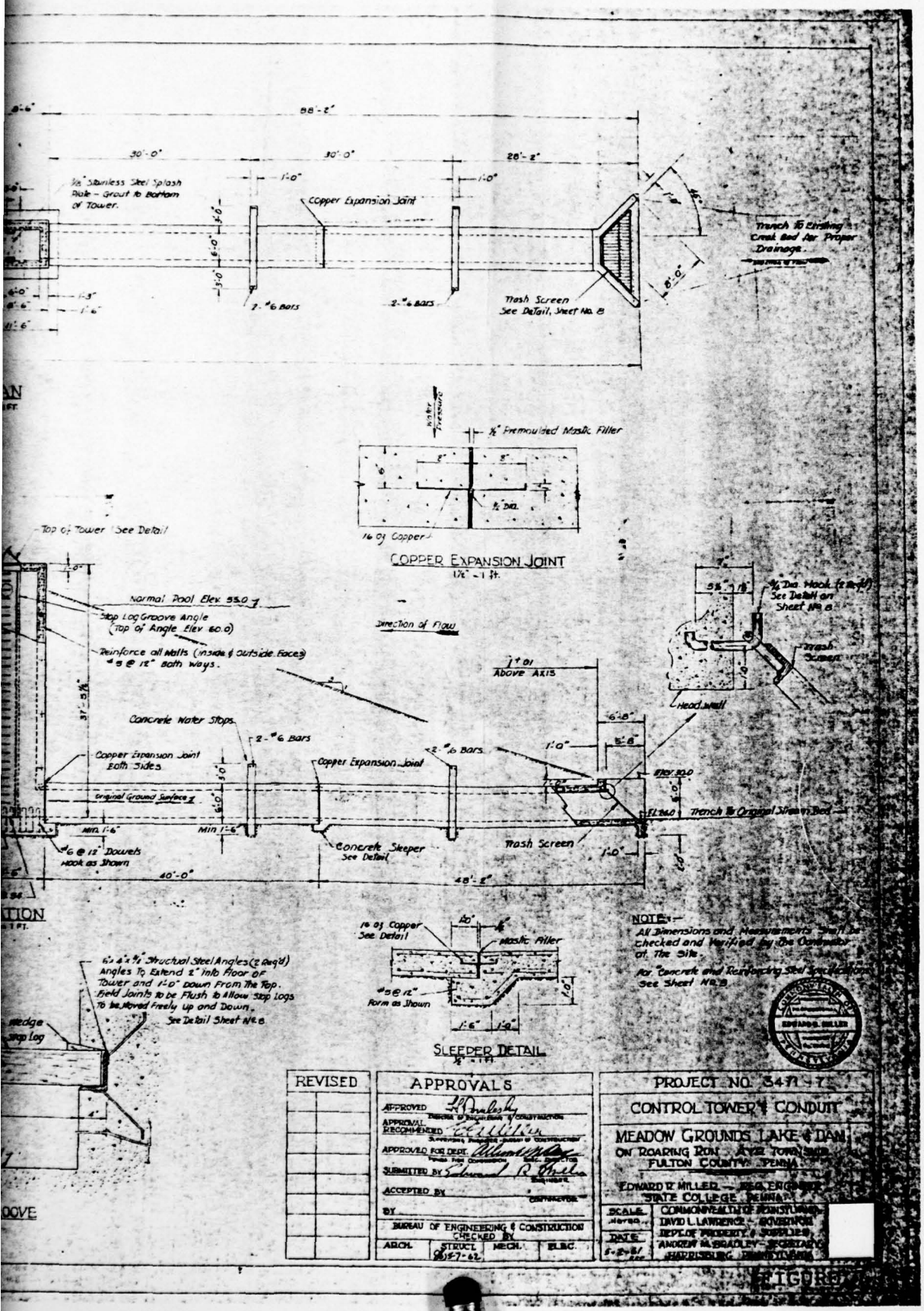
1. IMPERVIOUS CORE :- Shall be a Selected Impervious and Structurally Sound Material as Approved by the Engineer.
2. CLASS "A" FILL :- Shall be a Selected Sound Material Free From Vegetable Matter and Stone Greater than Six (6) inches in maximum Dimensions.
3. CLASS "B" FILL :- Shall be Composed of Structurally Sound materials Sufficiently Pervious To Drain the Embankment, and may Contain Stones but no Vegetable matter.
4. STONE RIP-RAP :- Shall be 20 inches in Thickness Laid on a Six (6) inch Layer of [illegible] Gravel or Crushed Stone Graded to a Uniform Surface.
5. Embankment Construction Details - See Written Specifications.
6. All Dimensions and Measurements Shall be Checked and Verified by the Contractor at the Site.

REVISED	APPROVALS	PROJECT NO. 3471-7
	APPROVED [signature] DIRECTOR OF ENGINEERING & CONSTRUCTION	EMBANKMENT CROSS SECTIONS
	APPROVAL RECOMMENDED [signature] SUPERVISING ENGINEER - BUREAU OF CONSTRUCTION	MEADOW GROUNDS LAKE & DAM ON ROARING RUN - AYR TOWNSHIP FULTON COUNTY, PENNA.
	APPROVED FOR DEPT. [signature] PENNA. FISH COMMISSION, DIST. DIRECTOR	EDWARD R. MILLER - REG. ENGINEER STATE COLLEGE, PA.
	SUBMITTED BY [signature] ENGINEER	SCALE: Noted
	ACCEPTED BY CONTRACTOR	DATE: 4-5-62
	BY	COMMONWEALTH OF PENNSYLVANIA DAVID L. LAWRENCE - GOVERNOR DEPT. OF PROPERTY & SUPPLIES ANDREW M. BRADLEY - SECRETARY HARRISBURG, PENNSYLVANIA
	BUREAU OF ENGINEERING & CONSTRUCTION CHECKED BY	
	ARCH. / STRUCT. [signature] 5-7-62 / MECH. / ELEC.	FIGURE 6

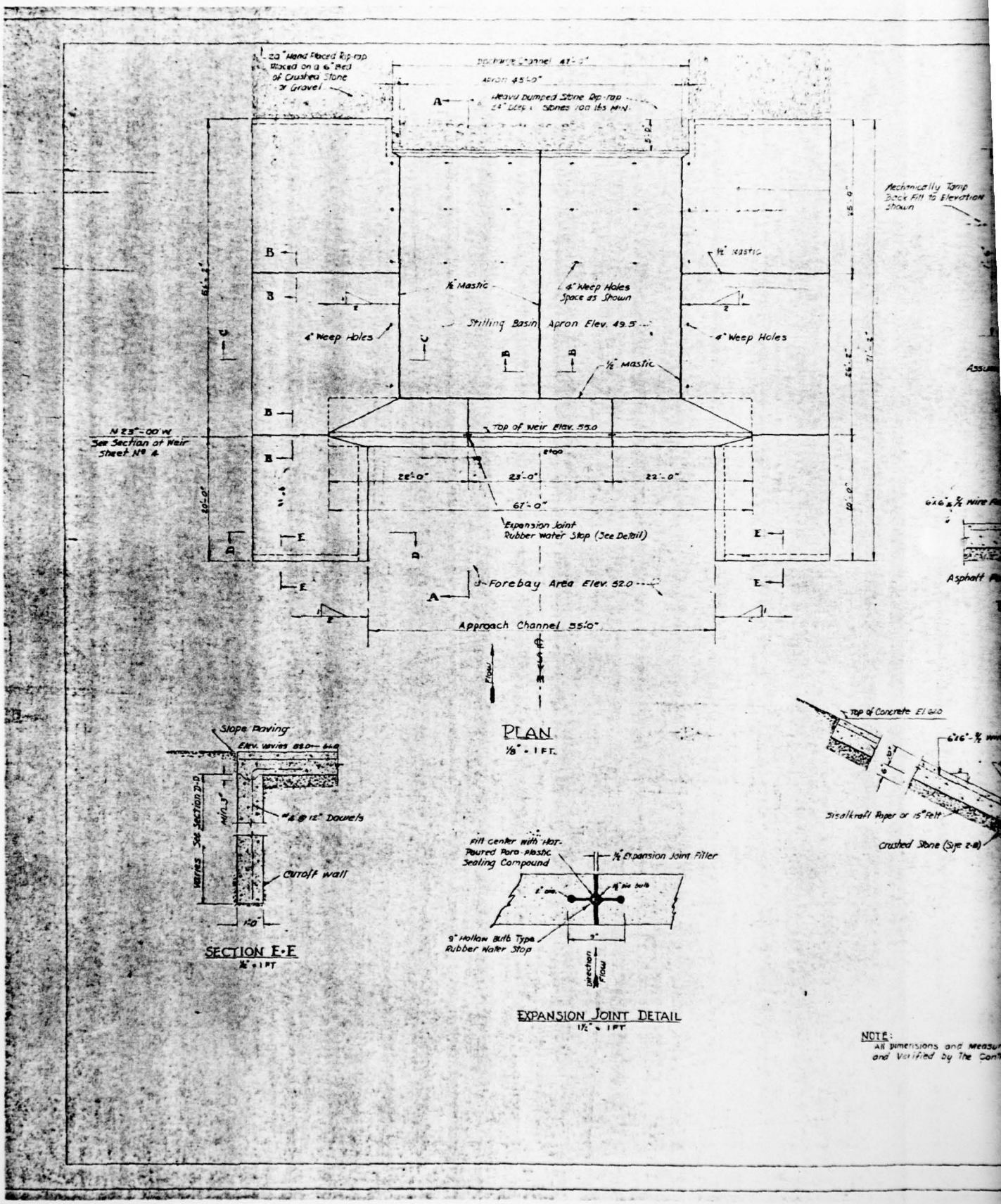
2



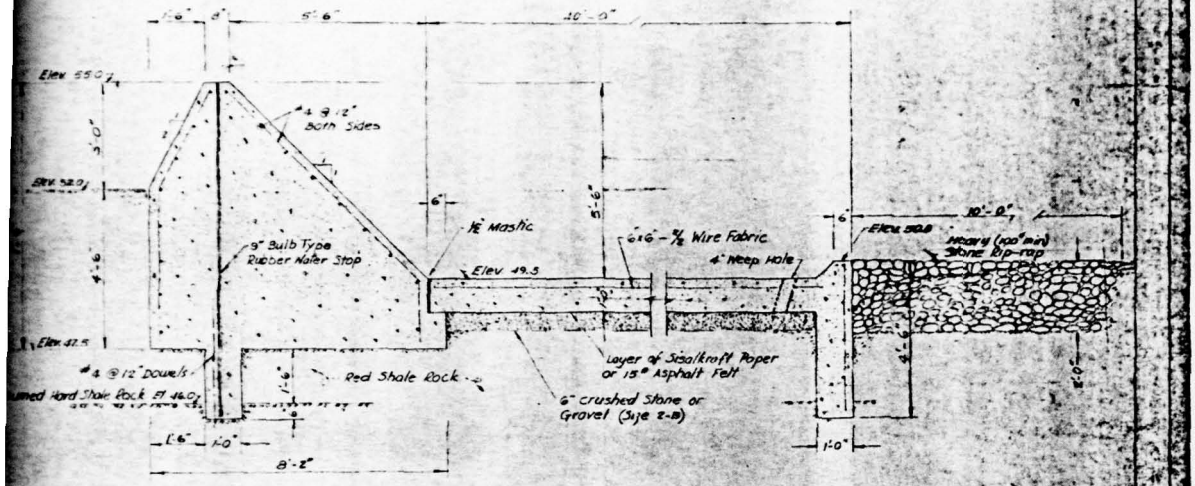
PLAN
1/8" = 1 FT.
Trench Outlet Channel To Existing Creek Bed
Copper Expansion Joint
See Section A-A for Reinforcing Steel in Culvert.
Reinforce Head Wall and Slab #5 @ 12" Both Ways, Each Face
2-#6 Bars
202'-4"
TOP OF TOWER
1/2" = 1 FT.
#6 Bar
5-#5 Bars Space as Shown
Ladder Bars See Detail Sheet No 8
Floor Plate
Hatch Cover & Frame See Detail Sheet No 8
LADDER BAR INST.
1 1/2" = 1 FT.
Tower Wall
Space Ladder Bars Evenly Both Sides of Tower See Sheet No 8 for Detail
El. 61.0 Top of Embankment
56 Ladder Bars Spaced 15" Apart - 28 ea. Side
All Construction Joints Must be Water Tight - Use 12 ga. Galv. Sheet Steel 12" Wide Thru. Joint.
Line of Embankment
0+88 Below Axis
Concrete Water Stop
Copper Expansion Joint
Expansion Joint See Detail
Trench To Original Creek Elev. 25.0
Slope of Culvert .005 #/ft
Concrete Steeper See Detail
2-#6 Bars on Each Face Around Opening
#5@12" Each Way
Elev. Floor of Tower - 23.54
ELEVATION
1/8" = 1 FT.
Paint Surface With Asphalt Paint Before Pouring Water Stop Around Conduit (Top & Sides)
Outline of Water Stop
Original Ground Surface
Avg. El. 26.0
2" Chamfer
#5@12" (Both Sides)
6" Dumbbell Type Rubber Water Stop (Continuous Strips)
Assumed Firm Foundation
SECTION A-A
1/2" = 1 FT.
Stop Logs - 6"x6"x5 ft. Long (69 Reqd.) Shall be Clear Straight Grained No 1 White Oak, S4S, No Wane Allowed.
Flow
Wedge Stop Log
Tower Wall
STOP LOG GROOVE
1/2" = 1 ft.



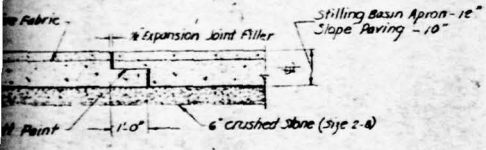
88'-2"
30'-0"
30'-0"
28'-2"
1/8" Stainless Steel Splash Plate - Grout to Bottom of Tower.
Copper Expansion Joint
Trench to Existing Creek Bed for Proper Drainage.
2-#6 Bars
2-#6 Bars
Trash Screen See Detail, Sheet No. 8
Water Pressure
1/2" Premoulded Mastic Filler
16 oz Copper
COPPER EXPANSION JOINT
1 1/2" = 1 ft.
Top of Tower See Detail
Normal Pool Elev. 55.0
Stop Log Groove Angle (Top of Angle Elev. 60.0)
Reinforce all Walls (inside & outside Faces) #5 @ 12" Both Ways.
Direction of Flow
1" Ø Above Axis
3/4" Dia. Hook (2 Req'd) See Detail on Sheet No. 8
Trash Screen
Head Wall
Concrete Water Stops
2-#6 Bars
2-#6 Bars
Copper Expansion Joint Both Sides
Copper Expansion Joint
Original Ground Surface
Min. 1'-6"
Min. 1'-6"
#6 @ 12" Dowels Hook as Shown
Concrete Sleeper See Detail
Trash Screen
Trench to Original Stream Bed
40'-0"
48'-2"
16 oz Copper See Detail
Mastic Filler
#5 @ 12" Form as Shown
SLEEPER DETAIL
1/2" = 1 ft.
6"x4"x3/8" Structural Steel Angles (2 Req'd) Angles To Extend 2" into Floor of Tower and 1'-0" Down From The Top. Field Joints to be Flush to Allow Stop Logs To be Moved Freely Up and Down. See Detail Sheet No. 8
Wedge Stop Log
NOTE:- All Dimensions and Measurements Shall be Checked and Verified by the Contractor at The Site.
For Concrete and Reinforcing Steel Specifications See Sheet No. 8
REVISED
APPROVALS
APPROVED
APPROVAL RECOMMENDED
APPROVED FOR DEPT.
SUBMITTED BY
ACCEPTED BY
BY
BUREAU OF ENGINEERING & CONSTRUCTION CHECKED BY
ARCH.
STRUCT.
MECH.
ELEC.
PROJECT NO. 3471-7
CONTROL TOWER & CONDUIT
MEADOW GROUNDS LAKE & DAM
ON ROARING RUN AYR TOWNSHIP
FULTON COUNTY PENNA.
EDWARD R. MILLER - REG. ENGINEER
STATE COLLEGE PENNA.
SCALE
DATE
COMMONWEALTH OF PENNSYLVANIA
DAVID L. LAWRENCE - GOVERNOR
DEPT. OF PROPERTY & SUPPLIES
ANDREW M. BRADLEY - SECRETARY
HARRISBURG PENNSYLVANIA
FIGURE



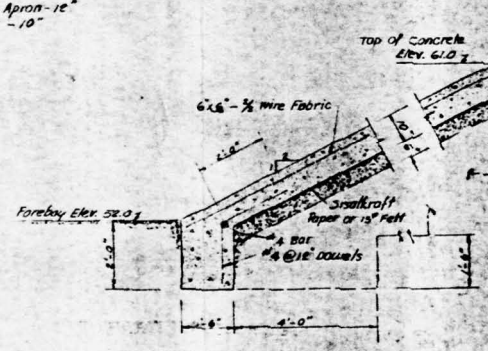
20" Hand Placed Rip-rap Placed on a 6" Bed of Crushed Stone or Gravel
Discharge Channel 47'-0"
Apron 45'-0"
Heavy Dumped Stone Rip-rap 24" Deep Stones 100 lbs Min.
Mechanically Tamp Back Fill to Elevation Shown
½" Mastic
4" Weep Holes Space as Shown
Stilling Basin Apron Elev. 49.5
4" Weep Holes
½" Mastic
N 23°-00' W See Section at Weir Sheet No 4
Top of Weir Elev. 55.0
22'-0"
23'-0"
22'-0"
67'-0"
Expansion Joint Rubber Water Stop (See Detail)
Forebay Area Elev. 52.0
Approach Channel 55'-0"
Flow
PLAN
⅛" = 1 FT.
Slope Paving
Elev. varies 58.0 — 64.0
#4 @ 12" Dowels
Varies See Section D-D
Min. 3"
Cutoff wall
1'-0"
SECTION E-E
½" = 1 FT
Fill center with Hot-Poured Para-plastic Sealing Compound
½" Expansion Joint Filler
9" Hollow Bulb Type Rubber Water Stop
Direction Flow
EXPANSION JOINT DETAIL
1½" = 1 FT
Top of Concrete El. 61.0
Sisalkraft Paper or 15# Felt
Crushed Stone (Size 2-8)
NOTE:
All Dimensions and Measure
and Verified by The Contr



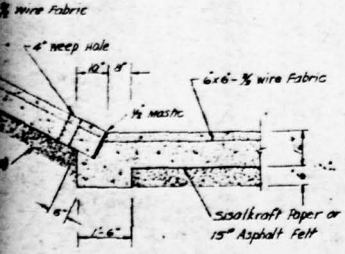
SECTION A-A
½" = 1 FT.



TYPE C CONTRACTION JOINT
SECTION B-B
½" = 1 FT.



SECTION D-D
½" = 1 FT.



SECTION C-C
½" = 1 FT.

easurements shall be checked Contractor at the Site.

REVISED

APPROVALS

APPROVED _____ DIRECTOR OF ENGINEERING & CONSTRUCTION

APPROVALS RECOMMENDED _____ SUPERVISING ENGINEER, BUREAU OF CONSTRUCTION

APPROVED FOR DEPT. _____ DEPUTY SECRETARY

SUBMITTED BY _____ ENGINEER

ACCEPTED BY _____ CONTRACTOR

BY _____

BUREAU OF ENGINEERING & CONSTRUCTION CHECKED BY

ARCH.	STRUCT. 6-5-62	MECH.	ELEC.

PROJECT NO. 3471-7

DETAILS - SPILLWAY STRUCTURE

MEADOW GROUNDS LAKE DAM
ON ROARING RUN - AYR TOWNSHIP
FULTON COUNTY, PENNA

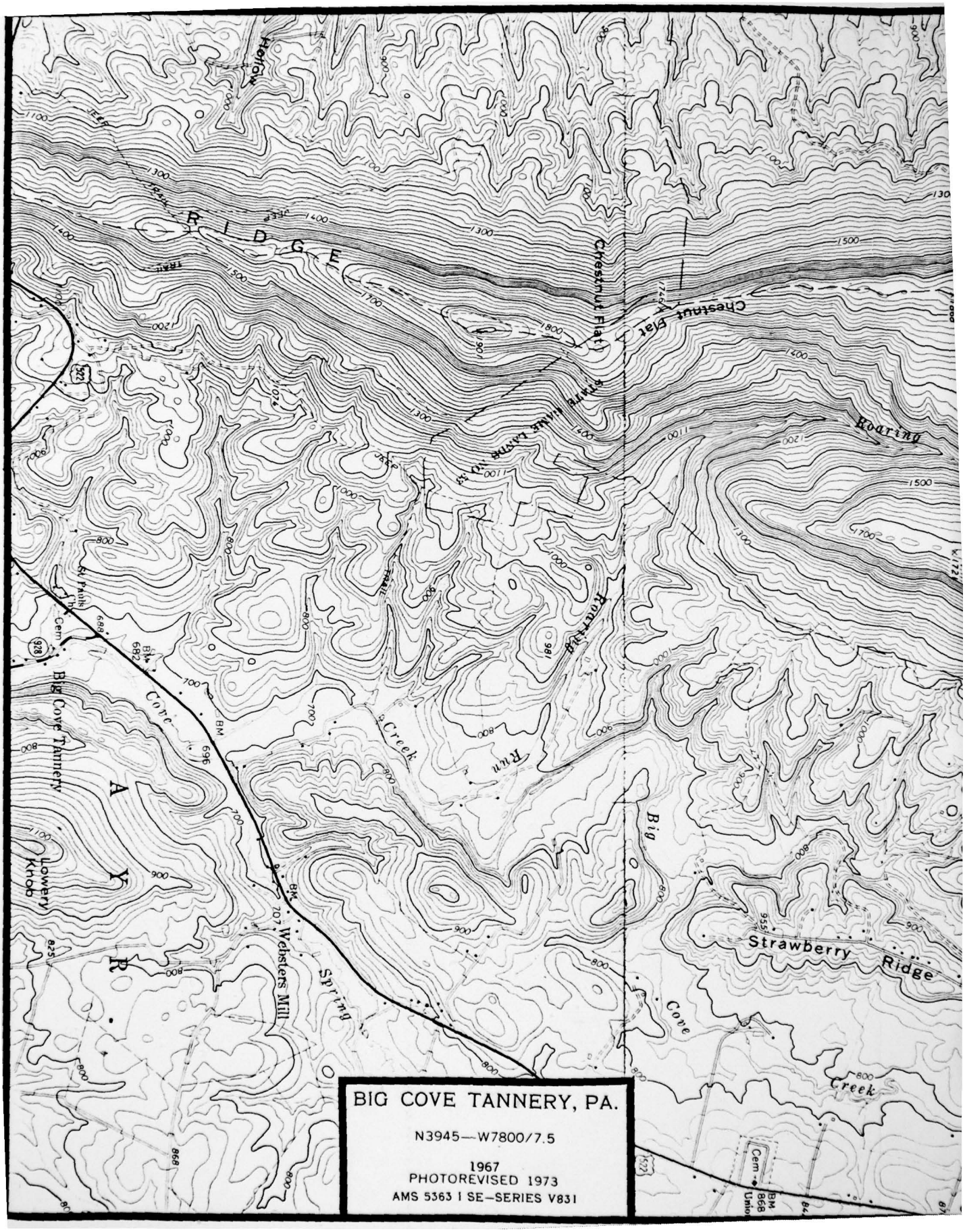
EDWARD R MILLER — — — REG. ENGINEER
STATE COLLEGE PA.

SCALE	COMMONWEALTH OF PENNSYLVANIA
noted	DAVID L. LAWRENCE - GOVERNOR
DATE	DEPT. OF PROPERTY & SUPPLIES
6-10-61	ANDREW M. BRADLEY - SECRETARY
	HARRISBURG, PENNSYLVANIA

FIGURE 8

APPENDIX G

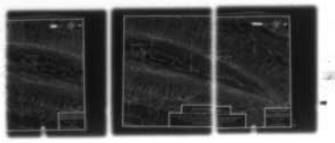
REGIONAL VICINITY AND WATERSHED BOUNDARY MAPS


RIDGE
Chestnut Flat
Chestnut Flat
Roaring
Roaring
Run
Creek
Big
Cove
Creek
Strawberry Ridge
Big Cove Tannery
Lowery Knob
Websters Mill
Spring
Cove
Creek
Cem
BM 868
Union
BM 682
BM 696
BM 707
BM 868
Hollow
JEEP TRAIL
STATE GAME LANDS NO. 33
St Pauls Ch
Cem
928
522
BIG COVE TANNERY, PA.
N3945—W7800/7.5
1967
PHOTOREVISED 1973
AMS 5363 I SE—SERIES V831

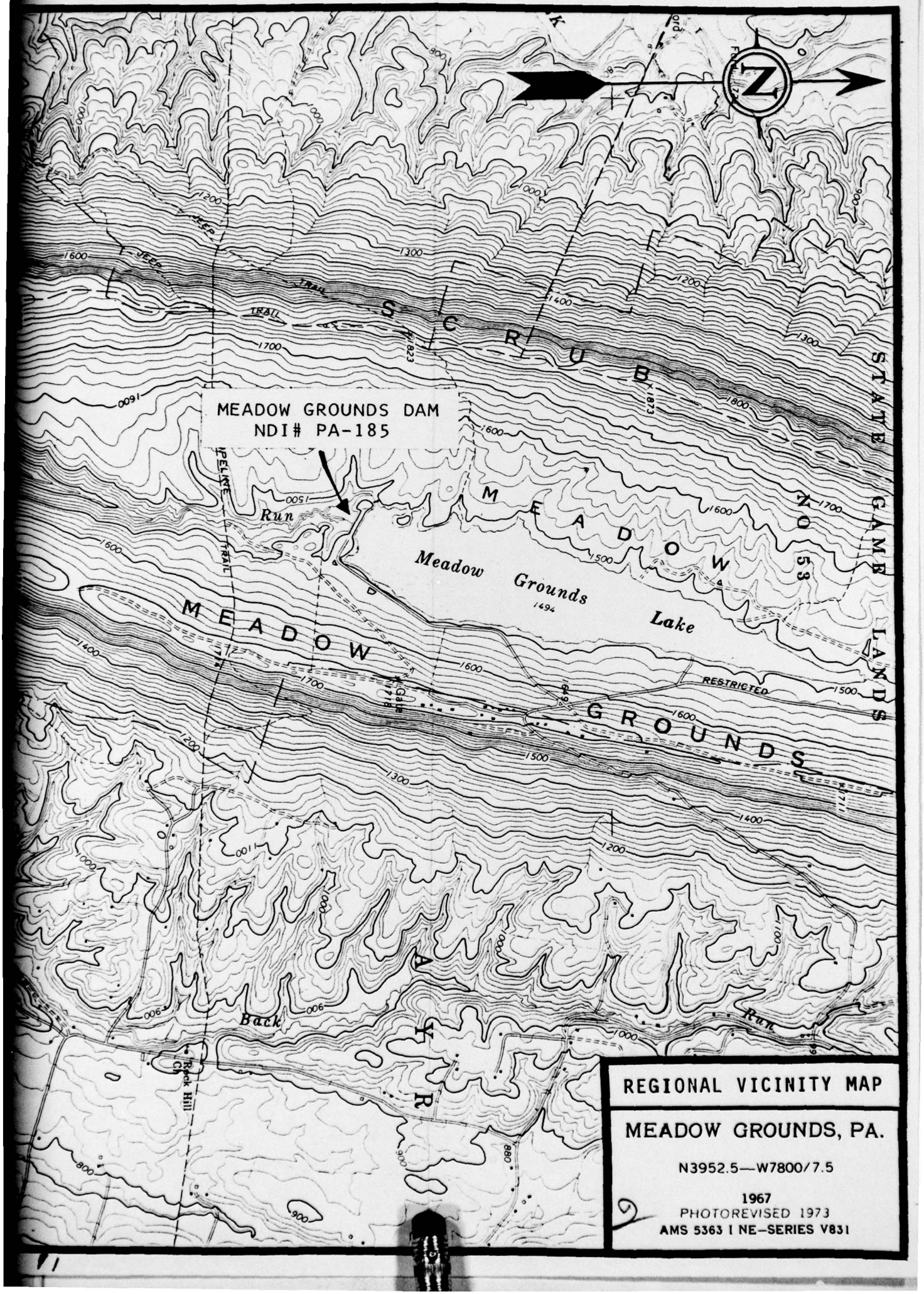
AD-A079 006 GAI CONSULTANTS INC MONROEVILLE PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. MEADOW GROUNDS DAM, NDS I.D. N--ETC(U)
AUG 79 B M MIHALCIN DACW31-79-C-0013

UNCLASSIFIED NL

2 OF 2
AD
A079 006



END
DATE
FILMED
2-80
DDC

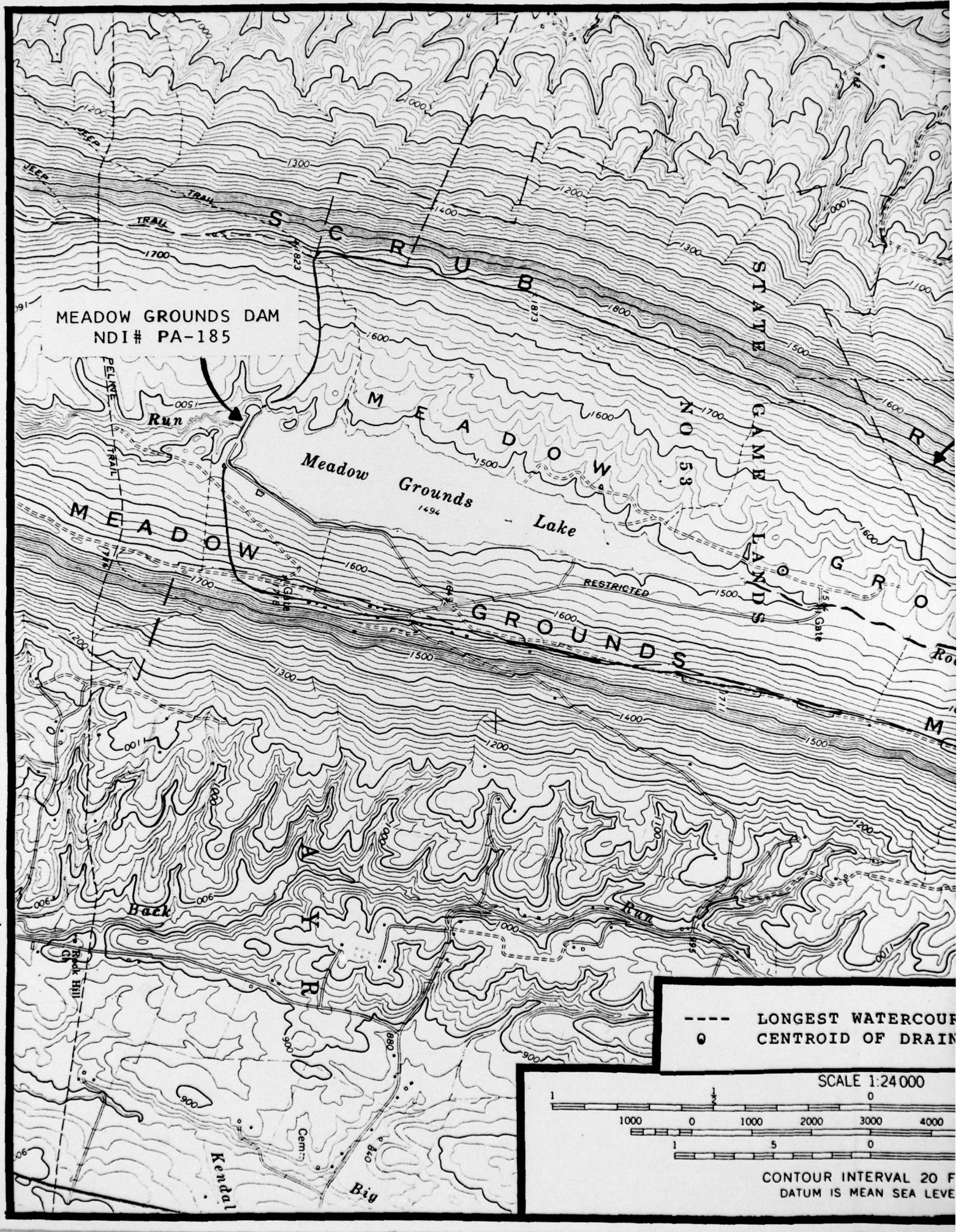


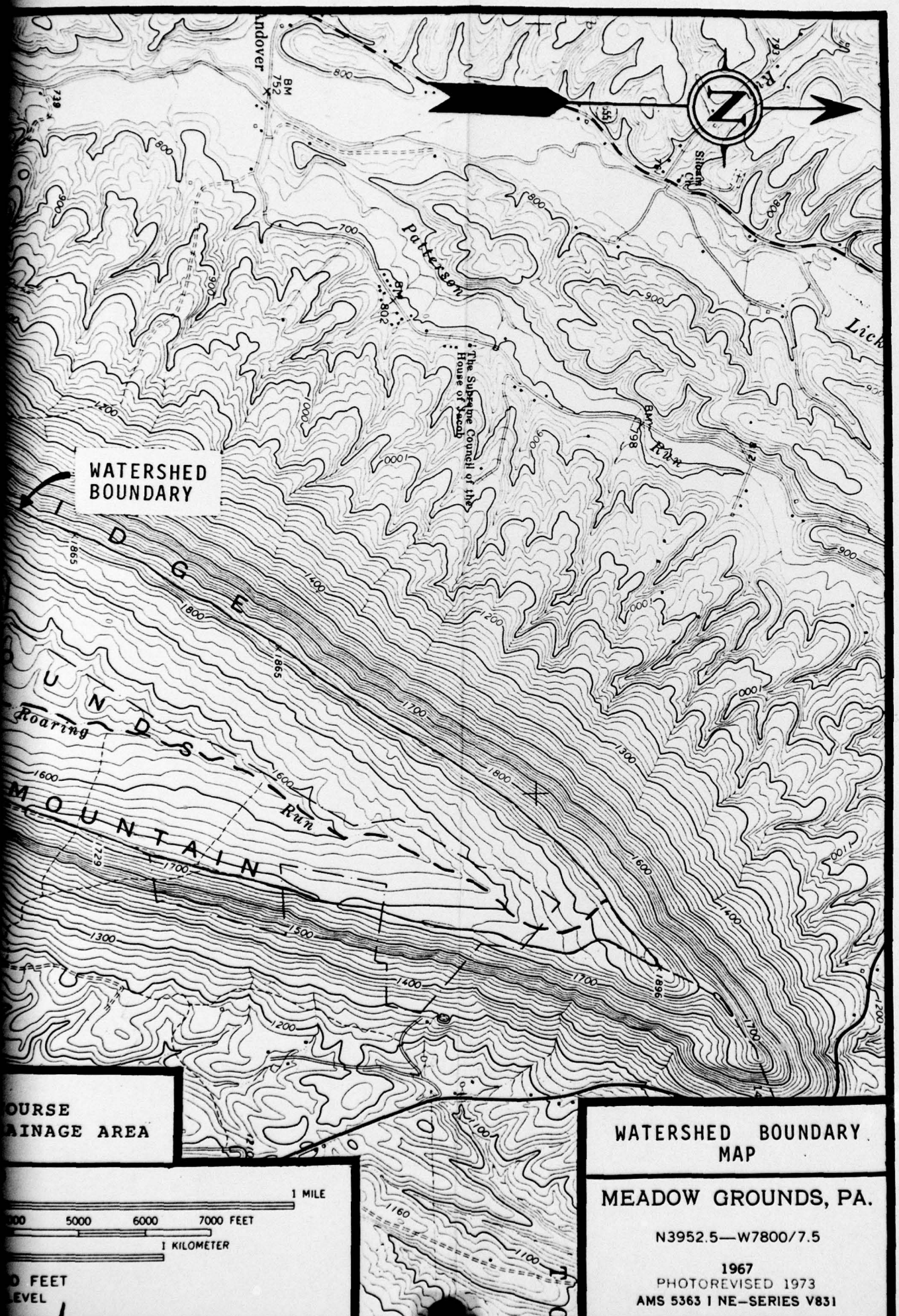
REGIONAL VICINITY MAP

MEADOW GROUNDS, PA.

N3952.5—W7800/7.5

1967
PHOTOREVISED 1973
AMS 5363 I NE—SERIES V831


MEADOW GROUNDS DAM
NDI# PA-185
SCRUB
MEADOW
Meadow Grounds Lake
1494
MEADOW GROUNDS
STATE GAME LANDS
NO 53
RESTRICTED
Gate
JEEP TRAIL
PELINE TRAIL
Run
Back Run
Rock Hill Ch
Kendal
Big
Cem
LONGEST WATERCOUR
CENTROID OF DRAIN
SCALE 1:24 000
CONTOUR INTERVAL 20 F
DATUM IS MEAN SEA LEVE


WATERSHED BOUNDARY
Andover
Patterson
Run
Roaring
Run
The Supreme Council of the House of Jacob
Lick
OURSE
AINAGE AREA
1 MILE
5000
6000
7000 FEET
1 KILOMETER
0 FEET
LEVEL
WATERSHED BOUNDARY MAP
MEADOW GROUNDS, PA.
N3952.5—W7800/7.5
1967
PHOTOREVISED 1973
AMS 5363 I NE—SERIES V831

2